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**(54) METHOD FOR MICROBIOLOGICALLY IDENTIFYING CHEMICAL SUBSTANCE**

**(57)Abstract:**

**PROBLEM TO BE SOLVED:** To provide a method for microbiologically identifying a sample chemical substance, because information for judging the property of toxicity or the kind of chemical substances causing the toxicity is not entirely afforded, though the bioassay utilized at present mainly measures only growth inhibition of unicell and the presence of the toxicity due to the chemical substances can be evaluated.

**SOLUTION:** This method for microbiologically identifying chemical substances features comprising a microorganism growth process for growing previously decided several kinds of marker microorganisms in the presence of the sample chemical substance under various concentrations of the sample chemical substance, a measurement process for measuring the relationship between the concentration of the sample chemical substance and the concentration of the marker microorganisms on the microorganism growth process and a comparison process for comparing the relationship between the concentration of the marker microorganisms and the concentration of the sample chemical substance obtained by the measurement process with the data showing the relationship between the concentration of a marker microorganism previously put away into a data bank and the concentration of a marker chemical substance.

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**CLAIMS**

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[Claim(s)]

[Claim 1] The microorganism growth process of changing the concentration of this sample chemical under existence of a sample chemical, and growing two or more sorts of index microorganisms defined beforehand, The measurement process which measures the relation of the sample chemical concentration and index microorganism concentration in this microorganism growth process, The microbiological identification approach of the chemical characterized by consisting of a collating process collated with the data in which the relation of the index microorganism concentration and index chemical concentration which are making the data bank contain beforehand the relation of the this index microorganism concentration and this sample chemical concentration which were obtained at this measurement process is shown.

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**DETAILED DESCRIPTION**

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[Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates to the microorganism-identification approach of a chemical.

[0002]

[Description of the Prior Art] Current, data base Chemical of a chemical The chemical of about 17 million affairs is registered into abstract. Among those, what 10,000 or more kinds of synthetic chemistry matter is accumulating into an environment is presumed, and the number is increasing every year. In the synthetic chemistry matter, after changing a form in direct or an environment, the matter which has a bad influence on ecology or the body is also contained. Therefore, it is necessary to evaluate quickly the effect which it has on ecology or the body about each chemical. Moreover, identification and the attempt which is going to carry out a quantum are made with various advanced gaging systems in the chemical which exists in an environment under the situation of being the social problem which an environmental pollution problem instigates national anxiety. However, no matter advanced

technique [ what ] it may use, in the present condition, it is said that about 10% of chemical can be identified. Therefore, it is more practical to establish the index which can express the toxicity of the chemical which exists in an environment rather than it identifies the strange chemical itself which exists in an environment. From the need mentioned above, toxic index-ization which used the simple toxicity evaluation trial (bioassay) in current and many engines is going to be made. It is the approach of measuring "change of the living thing-response by the chemical" using an animals-and-plants cell or a microorganism not using the bion in a bioassay, and evaluating "toxicity." However, the bioassay by which current use is carried out has only mainly measured the growth inhibition of a single cell. Although the toxic existence by the chemical can be estimated by this approach, the information for judging that toxic property and what kind of toxic chemical it is the toxicity resulting from is not acquired at all. [0003]

[Problem(s) to be Solved by the Invention] This invention makes it the technical problem to offer the approach of identifying a sample chemical microbiologically.

[0004]

[Means for Solving the Problem] this invention persons came to complete this invention, as a result of repeating research wholeheartedly that said technical problem should be solved. Namely, the microorganism growth process of according to this invention changing the concentration of this sample chemical under existence of a sample chemical, and growing two or more sorts of index microorganisms defined beforehand, The measurement process which measures the relation of the sample chemical concentration and index microorganism concentration in this microorganism growth process, The relation of the this index microorganism concentration and this sample chemical concentration which were obtained at this measurement process The microbiological identification approach of the chemical characterized by consisting of a collating process collated with the data in which the relation of the index microorganism concentration and index chemical concentration which the data bank is made to contain beforehand is shown is offered.

[0005]

[Embodiment of the Invention] The data bank for identifying the sample chemical microbiologically is used for the approach of this invention. This data bank is made to contain the data in which the relation of the index chemical concentration and index microorganism concentration which were measured beforehand is shown. Much data (only henceforth a microorganism / chemical concentration data) in which the relation of the index chemical concentration and index microorganism concentration which this data bank is made to contain is shown come out as much as possible, a certain thing is desirable, and when its microorganism / chemical concentration data is obtained newly, it is desirable to make the data bank contain that data quickly. It is good to make a microorganism / chemical concentration data and to make the data bank contain this using two or more sorts of index chemical matter which was beforehand determined as two or more sorts of index microorganisms defined beforehand in the case of this invention.

[0006] What shows inhibition nature to a microorganism as an index chemical is used. What shows the growth inhibition nature to the Escherichia coli shown below as such a thing was chosen. In the parenthesis after the compound made into the following, the minimum inhibition concentration to Escherichia coli is shown.

[0007] No.1 Methylmercury chloride (0.91microM)

No.2 Nickel chloride (1111microM)

No.3 2-Aminoanthracene (370microM)

No.4 Tributyltin chloride (0.1microM)

No.5 Malathion (222microM)

No.6 Phenol(17mM)

No.7 Lindane (6666microM)

- No.8 Pentachlorophenol (74microM)
- No.9 Trp-P -2 (Acetate) (37microM)
- No.10 4-Nitroquinoline-N-oxide (567microM)
- No.11 Benzo(a) pyrene (111microM)
- No.12 Paraquat (333microM)
- No.13 Maneb (37microM)
- No.14 Cadmium chloride (333microM)
- No.15 Bis phenol-A (123microM)
- No.16 Di-2-ethylhexyl phthalate (92.6microM)
- No.17 2, 5-Dichlorophenol (13.7microM)
- No.18 2, 4-Dichlorophenoxy acetic acid (247microM)
- No.19 Formaldehyde (555microM)
- No.20 p-Nonylphenol (666microM)
- No.21 Sodium Arsenite (111microM)
- No.22 Thiuram (12.3microM)
- No.23 2, 4, 5-Trichlorophenol (13.7microM)
- No.24 potassium dichromate (33microM)
- No.25 Triphenyltin chloride (3.3microM)

[0008] Although 25 sorts were shown in the above about the index chemical, in order to perform more exact microbiological identification of a chemical, it is clear that it is desirable to select many chemicals as much as possible. Therefore, as for an index chemical, it is natural that it is not what is limited to the above-mentioned thing.

[0009] Although it is desirable to choose many things from which the class differed as an index microorganism, it is as follows when the example of the index microorganism is shown.

(1) *Acetobacter pasteurianus* IFO 3188 -- this microorganism is a microorganism which shows susceptibility to chloromethylmercury (methylmercury chloride). That growth is prevented nearly completely under about M 1micro existence of chloromethylmercury, and this microorganism produces clear growth inhibition also by 0.3micro concentration which is about M. The susceptibility over other chemicals is shown in Table 1.

(2) *Acetobacter pasteurianus* IFO 3129 -- this microorganism is a microorganism which shows susceptibility to a nickel chloride. This microorganism remained in the bottom of about M 0.17micro existence of a nickel chloride that about 60% of growth is shown. The susceptibility over other chemicals is shown in Table 2.

(3) *Glyosomyces rutgersensis* IFO 14488 -- this microorganism is a microorganism which shows susceptibility to 2-amino anthracene. This microorganism shows susceptibility also in about [ 2-amino anthracene 4.6microM ] concentration. The susceptibility over other chemicals is shown in Table 3.

(4) *Aureobacterium esteraromatium* IFO 3752 -- this microorganism is a microorganism which shows susceptibility to chlorination tributyltin. This microorganism shows susceptibility to 0.003micro about M low concentration to chlorination tributyltin. The susceptibility over other chemicals is shown in Table 4.

(5) *Comamonas Testosteroni* IAM 1048 -- this microorganism is a microorganism which shows susceptibility to a malathion (Malathion). This microorganism produced clear growth inhibition under about M 0.3micro existence of a malathion. The susceptibility over other chemicals is shown in Table 5.

(6) *Pseudomonas synxantha* IFO 3913 -- this microorganism is a microorganism which shows susceptibility to a phenol. This microorganism showed clear growth inhibition by about M phenol 23micro concentration. The susceptibility over other chemicals is shown in Table 6.

(7) *Staphylococcus aureus* IFO 3060 -- this microorganism is a microorganism which shows susceptibility to the lindane (Lindane). This microorganism showed growth inhibition also in about lindane 0.34microM. The susceptibility over other chemicals is shown in Table 7. In

seven kinds of microorganisms shown above, the susceptibility over a chemical shows strong susceptibility to a chemical which differed and is different, respectively.

[0010] Growth (culture) of an index microorganism was performed using L culture medium (1% of yeast extracts, poly peptone 0.5%). Growth was performed at 25 degrees C on 96 hole microplate, and the growth (microorganism concentration) was observed with the absorbance of 650nm. In this case, to the culture medium, the predetermined chemical was added by predetermined concentration. The susceptibility (a microorganism / chemical concentration data) of said index microorganism to said index chemical is shown in anaphase Table 1 - 7. In addition, in Tables 1-7 shown below, a numeric value with an absorbance of 650nm shown in the column of growth is equivalent to the numeric value of the concentration (muM) of the chemical shown in the upper column. For example, the absorbances 102 and 0.116 of the column of the growth in (1) *Acetobacter pasteurianus* IFO3188 of Table 1 are equivalent to the concentration (muM) 0.000 and 0.034 of Methylmercury chloride of the upper column.

[0011]

[Table 1] (1) *Acetobacter pasteurianus* The chemical susceptibility Methylmercury of IFO3188 chloride Concentration (muM) 0.000 0.034 0.102 0.305 0.914 2.7418.222 24.667 74.000 222.000 666.000 growth () [ Absorbance ] at 650nm0.102 0.116 0.108 0.085 0.024 0.021 0.0240.025 0.024 0.024 0.018Nickel chloride Concentration (muM) 0.000 0.169 0.508 1.524 4.572 13.716 41.148123.444370. [333 ] 1111. 000 3333. 000 growth () [ Absorbance ] at 650nm0.109 0.113 0.112 0.1190.114 0.114 0.1140.117 0.100 0.012 0.0132-Aminoanthracene Concentration (muM) 0.000 0.169 0.508 1.524 4.572 13.716 41.148123.444 370.333 1111. -- 000 3333.000 growth (Absorbance at 650nm) 0.101 0.109 0.116 0.110 0.107 0.106 0.0900.089 0.065-0.048 - 0.091 Tributyltin chloride Concentration (muM) 0.000 0.003 0.010 0.0300.091 0.2720.815 2.444 7.333 22.000 66.000 growth (Absorbance at 650nm) 0.104 0.049 0.048 0.049 0.046 0.040 0.0180.016 0.011 0.015 0.024Malathion Concentration (muM) 0.000 0.034 0.102 0.305 0.914 2.741 8.222 24.66774.000 222.000 666.000 growth () [ Absorbance ] at 650nm0.111 0.111 0.127 0.120 0.126 0.120 0.1230.120 0.108 0.081 - 0.003Phenol Concentration (muM) 0.000 0.847 2.540 7.620 22.861 68.584 205.753 617.2591851.778 5555.333 16666. 000 growth () [ Absorbance ] at 650nm0.107 0.112 0.124 0.108 0.107 0.099 0.0800.075 0.038 0.027 0.018Lindane(s) Concentration (muM) 0.000 0.339 1.016 3.048 9.144 27.432 82.296 246.889740.667 2222.000 6666. 000 growth () [ Absorbanceat ] 650nm0.108 0.111 0.119 0.121 0.118 0.085 0.0700.094 0.100 0.094-0.063Pentachlorophenol concentration (muM) 0.000 0.034 0.102 0.305 0.914 2.741 8.22224.667 74.000 222.000 666.000 growth () [ Absorbance ] at 650nm0.104 0.113 0.123 0.111 0.086 0.037 0.0180.018 0.018 0.0170.014 Trp-P -2 (Acetate) Concentration (muM) 0.000 0.017 0.051 0.152 0.457 1.370 4.11112.333 37.000 111.000 333.000 growth () [ Absorbance ] at 650nm0.098 0.120 0.121 0.110 0.111 0.102 0.0740.061 0.039 0.015 0.0744-Nitroquinoline-N-oxide 0.000 0.001 0.003 0.008 0.023 0.0700.210 0.630 1.889 5.667 17.000 growth Concentration (muM) () [ Absorbance ] at 650nm0.121 0.114 0.121 0.112 0.120 0.109 0.1040.098 0.082 0.018 0.014Benzo(es)(a) pyrene Concentration (muM) 0.000 0.017 0.051 0.152 0.457 1.3704.11112.333 37.000 111.000 333.000 growth (Absorbance at 650nm) 0.093 0.090 0.121 0.120 0.120 0.115 0.1110.095 0.081 0.060 0.051Paraquat Concentration (muM) 0.000 0.051 0.152 0.457 1.372 4.115 12.346 37.037111.111 333.333 1000.000 growth (Absorbance at 650) nm) 0.110 0.107 0.114 0.107 0.103 0.093 0.0750.059 0.024 0.017 0.015Maneb Concentration (muM) 0.000 0.017 0.051 0.152 0.457 1.370 4.111 12.333 37.000111.000 333.000 growth () [ Absorbance ] at 650nm0.111 0.116 0.127 0.123 0.125 0.120 0.1140.085 0.014 0.009 0.018Cadmium chloride Concentration (muM) 0.000 0.017 0.051 0.152 0.457 1.3704.11112.333 37.000 111.000 333.000 growth (Absorbance at 650nm) 0.106 0.098 0.115 0.115 0.111 0.102 0.0900.055 0.020 0.017 0.016 Bis-phenol-A Concentration (muM) 0.000 0.169 0.508 1.524 4.572 13.716 41.148123.444 370.333 1111.000 3333. 000 growth ()

[ Absorbance ] at 650nm 0.090 0.095 0.121 0.125 0.119 0.112 0.095 0.063 0.021 0.020  
0.070 Di(s)-2-ethylhexyl phthalate concentration (muM) 0.000 0.042 0.127 0.381 1.143  
3.428 10.284 30.852 92.556 277.667 833.000 growth () [ Absorbance ] at 650nm 0.091 0.087  
0.118 0.114 0.118 0.116 0.110 0.094 0.066 0.047 0.0522 and 5-Dichlorophenol  
Concentration (muM) 0.000 0.169 0.508 -- 1.524 4.572 13.716 41.148 123.444 370.333  
1111.000 3333.000 growth (Absorbance at 650nm) 0.098 0.090 0.121 0.122 0.126 0.127  
0.106 0.070 0.021 0.017 0.0172 and 4-Dichlorophenoxy acetic acid Concentration (muM)  
0.000 0.339 1.016 3.048 9.144 27.432 82.296 246.889 740.667 -- 2222.000 6666.000 growth  
(Absorbance at 650nm) 0.099 0.098 0.118 0.126 0.119 0.121 0.115 0.107 0.081 0.018  
0.021 Formaldehyde Concentration (muM) 0.000 0.085 0.254 0.762 2.285 6.856  
20.568 61.704 185.111 555.333 -- 1666.000 growth (Absorbance at 650nm) 0.109 0.098  
0.116 0.116 0.115 0.114 0.112 0.086 0.048 0.019 0.015 p-Nonylphenol Concentration (muM)  
0.000 0.034 0.102 0.305 0.914 2.741 8.222 24.667 74.000 222.000 666.000 growth ()  
[ Absorbance ] at 650nm 0.108 0.086 0.126 0.126 0.112 0.020 0.014 0.011 0.012 0.024  
0.099 Sodium Arsenite Concentration (muM) 0.000 0.017 0.051 0.152 0.457 1.370  
4.111 12.333 37.000 111.000 333.000 growth () [ Absorbance ] at 650nm 0.111 0.113 0.121  
0.122 0.125 0.121 0.123 0.112 0.047 0.026 0.009 Thiuram Concentration (muM) 0.000 0.017  
0.051 0.152 0.457 1.370 4.111 12.333 37.000 111.000 333.000 growth () [ Absorbance ] at  
650nm 0.112 0.107 0.113 0.106 0.105 0.080 0.050 0.027 0.018 0.013 0.0132, 4, and 5-  
Trichlorophenol Concentration (muM) 0.000 0.169 0.508 1.524 4.572 13.716 41.148 123.444  
370.333 1111.000 3333.000 growth () [ Absorbance ] at 650nm 0.118 0.113 0.122 0.109  
0.065 0.019 0.018 0.018 0.016 0.020 0.027 Potassium dichromate Concentration (muM) 0.000  
0.002 0.005 0.015 0.045 0.136 0.407 1.222 3.667 11.000 33.000 growth (Absorbance at  
650nm) 0.115 0.107 0.114 0.113 0.111 0.110 0.116 0.115 0.112 0.104 0.079 Triphenyltin  
chloride Concentration (muM) 0.000 0.000 0.001 0.002 0.005 0.014 0.041 0.122 0.367 1.100  
3.300 growth (Absorbance at 650nm) -- 0.107 0.112 0.110 0.106 0.105 0.106 0.100 0.108  
0.104 0.091 -- 0.083 [0012]  
[Table 2] (2) *Acetobacter pasteurianus* The chemical susceptibility Methylmercury of  
IFO3129 chloride Concentration (muM) 0.000 0.034 0.102 0.305 0.914 2.741 8.222 24.667  
74.000 222.000 666.000 growth () [ Absorbance ] at 650nm 0.260 0.313 0.292 0.269 0.165  
0.036 0.047 0.047 0.041 0.034 0.032 Nickel chloride Concentration (muM) 0.000 0.169 0.508  
1.524 4.572 13.716 41.148 123.444 370.333 1111.000 3333.000 growth () [ Absorbance ]  
at 650nm 0.556 0.345 0.265 0.264 0.261 0.265 0.584 0.272 0.480 0.114 0.0262-  
Aminoanthracene Concentration (muM) 0.000 0.169 0.508 1.524 4.572 13.716  
41.148 123.444 370.333 1111.000 -- 000 3333.000 growth (Absorbance at 650nm) 0.272 0.296  
0.284 0.269 0.267 0.264 0.237 0.198 0.166 0.031-0.040 Tributyltin chloride Concentration  
(muM) 0.000 0.003 0.010 0.030 0.091 0.272 0.815 2.444 7.333 22.000 66.000 growth ()  
[ Absorbance ] at 650nm 0.278 0.047 0.047 0.047 0.046 0.046 0.039 0.025 0.013 0.016  
0.030 Malathion(s) Concentration (muM) 0.000 0.034 0.102 0.305 0.914 2.741 8.222  
24.667 74.000 222.000 666.000 growth (Absorbance at 650nm) 0.265 0.252 0.255 0.253 0.243  
0.230 0.231 0.223 0.214 0.168 0.083 Phenol(s) Concentration (muM) 0.000 0.847 2.540 7.620  
22.861 68.584 205.753 617.259 1851.778 5555.333 16666.000 growth () [ Absorbance ] at  
650nm 0.323 0.300 0.323 0.305 0.289 0.283 0.267 0.224 0.178 0.071 0.032 Lindane(s)  
Concentration (muM) 0.000 0.339 1.016 3.048 9.144 27.432 82.296 246.889 740.667  
2222.000 6666.000 growth () [ Absorbance at ] 650nm 0.234 0.234 0.235 0.235 0.221 0.168  
0.137 0.164 0.158 0.132-0.114 Pentachlorophenol concentration (muM) 0.000 0.034 0.102  
0.305 0.914 2.741 8.222 24.667 74.000 222.000 666.000 growth () [ Absorbance ] at  
650nm 0.271 0.228 0.213 0.199 0.155 0.073 0.029 0.021 0.023 0.021 0.021 Trp-P -2 (Acetate)  
Concentration (muM) 0.000 0.017 0.051 0.152 0.457 1.370 4.111 12.333 37.000 111.000  
333.000 growth () [ Absorbance ] at 650nm 0.648 0.580 0.288 0.285 0.274 0.140 0.070 0.036  
0.023 0.023 0.068 4-Nitroquinoline-N-oxide 0.000 0.001 0.003 0.008 0.023 0.070 0.210 0.630

1.889 5.667 17.000 growth Concentration (muM) () [ Absorbance ] at 650nm 0.296 0.299  
 0.298 0.303 0.303 0.289 0.2810.240 0.154 0.021 0.024 Benzo(es)(a) pyrene Concentration  
 (muM) 0.000 0.017 0.051 0.152 0.457 1.370 4.111 12.333 37.000 111.000 333.000 growth  
 (Absorbance at 650nm) 0.077 0.079 0.078 0.079 0.076 0.074 0.071 0.054 0.047 0.047  
 0.048 Paraquat Concentration (muM) 0.000 0.051 0.152 0.457 1.372 4.115 12.346  
 37.037 111.111 1000.333.333 000 growth (Absorbance at 650nm) -- 0.349 0.311 0.314 0.276  
 0.236 0.193 0.156 0.123 0.049 0.032 0.024 Maneb(s) Concentration (muM) 0.000 0.017 0.051  
 0.152 0.457 1.370 4.111 12.333 37.000 111.000 333.000 growth (Absorbance at 650nm)  
 0.341 0.323 0.371 0.332 0.671 0.601 0.597 0.250 0.642 0.059 0.027 Cadmium chloride  
 Concentration (muM) 0.000 0.017 0.051 0.152 0.457 1.370 4.111 12.333 37.000 111.000  
 333.000 growth () [ Absorbance ] at 650nm 0.252 0.247 0.245 0.227 0.210 0.192 0.160 0.120  
 0.021 0.017 0.024 Bis-phenol-A Concentration (muM) 0.000 0.169 0.508 1.524 -- 4.572  
 13.716 41.148 123.444 370.333 1111.000 3333.000 growth (Absorbance at 650nm) 0.246  
 0.257 0.242 0.250 0.242 0.225 0.201 0.090 0.030 0.024 0.178 Di-2-ethylhexyl phthalate  
 Concentration (muM) 0.000 0.042 0.127 0.381 1.143 3.428 10.284 30.852 92.556 277.667  
 833.000 growth () [ Absorbance ] at 650nm 0.245 0.235 0.235 0.234 0.238 0.223 0.213 0.188  
 0.159 0.119 0.055 2 and 5-Dichlorophenol Concentration (muM) 0.000 0.169 0.508 -- 1.524  
 4.572 13.716 41.148 123.444 370.333 1111.000 3333.000 growth (Absorbance at 650nm)  
 0.252 0.264 0.260 0.262 0.235 0.238 0.230 0.193 0.036 0.029 0.024 2 and 4-Dichlorophenoxy  
 acetic acid Concentration (muM) 0.000 0.339 1.016 3.048 9.144 27.432 82.296 246.889  
 740.667 -- 2222.000 6666.000 growth (Absorbance at 650nm) 0.248 0.262 0.257 0.265 0.254  
 0.246 0.218 0.191 0.135 0.032 0.045 Formaldehyde Concentration (muM) 0.000 0.085 0.254  
 0.762 2.285 6.856 20.568 61.704 185.111 555.333 -- 1666.000 growth (Absorbance at  
 650nm) 0.252 0.266 0.248 0.247 0.262 0.233 0.227 0.174 0.035 0.034 0.033 p-Nonylphenol  
 Concentration (muM) 0.000 0.034 0.102 0.305 0.914 2.741 8.222 24.667 74.000 222.000  
 666.000 growth () [ Absorbance ] at 650nm 0.280 0.271 0.275 0.269 0.249 0.185 0.012 0.010  
 0.010 0.014 0.042 Sodium Arsenite Concentration (muM) 0.000 0.017 0.051 0.152 0.457  
 1.370 4.111 12.333 37.000 111.000 333.000 growth () [ Absorbance ] at 650nm 0.281 0.265  
 0.234 0.165 0.279 0.282 0.265 0.259 0.166 0.036 0.013 Thiuram Concentration (muM) 0.000  
 0.017 0.051 0.152 0.457 1.370 4.111 12.333 37.000 111.000 333.000 growth ()  
 [ Absorbance ] at 650nm 0.286 0.294 0.331 0.383 0.279 0.361 0.270 0.150 0.041 0.035 0.  
 0252, 4, and 5-Trichlorophenol Concentration (muM) 0.000 0.169 0.508 1.524 4.572  
 13.716 41.148 123.444 370.333 1111.000 3333.000 growth () [ Absorbance ] at 650nm 0.285  
 0.270 0.265 0.201 0.110 0.027 0.026 0.023 0.022 0.035 0.046 Potassium dichromate  
 Concentration (muM) 0.000 0.002 0.005 0.015 0.045 0.136 0.407 1.222 3.667 11.000 33.000  
 growth (Absorbance at 650nm) 0.281 0.267 0.546 0.276 0.275 0.736 0.271 0.264 0.259 0.473  
 0.218 Triphenyltin chloride Concentration (muM) 0.000 0.000 0.001 0.002 0.005 0.014 0.041  
 0.122 0.367 1.100 3.300 growth (Absorbance at 650nm) -- 0.323 0.454 0.311 0.303 0.476  
 0.288 0.287 0.290 0.275 0.273 -- 0.240 [0013]  
 [Table 3] (3) *Glyosomyces rutgersensis* Chemical susceptibility Methylmercury chloride of  
 IFO14488 Concentration (muM) 0.000 0.034 0.102 0.305 0.914 2.741 8.222 24.667 74.000  
 222.000 666.000 growth () [ Absorbance ] at 650nm 0.066 0.065 0.069 0.068 0.047 0.042  
 0.038 0.032 0.026 0.021 0.018 Nickel chloride Concentration (muM) 0.000 0.169 0.508 1.524  
 4.572 13.716 41.148 123.444 370.333 1111.000 3333.000 growth () [ Absorbance ] at  
 650nm 0.041 0.038 0.039 0.042 0.042 0.044 0.042 0.040 0.025 0.025 0.024 2-Aminoanthracene  
 Concentration (muM) 0.000 0.169 0.508 1.524 4.572 13.716  
 41.148 123.444 370.333 1111. -- 000 3333.000 growth (Absorbance at 650nm) 0.076 0.070  
 0.076 0.069 0.061 0.058 0.047 0.029 0.003 - 0.015 - 0.157 Tributyltin chloride Concentration  
 (muM) 0.000 0.003 0.010 0.030 0.091 0.272 0.815 2.444 7.333 22.000 66.000 growth  
 (Absorbance at 650nm) 0.058 0.053 0.052 0.051 0.050 0.043 0.037 0.029 0.025 0.026  
 0.036 Malathion Concentration (muM) 0.000 0.034 0.102 0.305 0.914 2.741 8.222



24.66774.000 222.000 666.000 growth () [ Absorbance ] at 650nm0.059 0.052 0.053 0.052  
 0.054 0.053 0.0540.051 0.048 0.045 0.006Phenol(s) Concentration (muM) 0.000 0.847 2.540  
 7.620 22.861 68.584 205.753 617.2591851.778 5555.333 16666. 000 growth ()  
 [ Absorbance ] at 650nm0.044 0.059 0.059 0.061 0.059 0.0540.0500.047 0.038 0.032  
 0.025Lindane Concentration (muM) 0.000 0.339 1.016 3.048 9.144 27.432 82.296  
 246.889740.667 2222. 0006666.000 growth (Absorbance at650nm) 0.049 0.046 0.046 0.050  
 0.049 0.048 0.0490.066 0.073 0.090-0.082Pentachlorophenol Concentration (muM) 0.000  
 0.034 0.102 0.305 0.914 2.741 8.22224.667 74.000 222.000 666.000 growth ()  
 [ Absorbance ] at 650nm0.052 0.049 0.049 0.046 0.044 0.038 0.0290.027 0.028 0.028 0.030  
 Trp-P -2 (Acetate) Concentration (muM) 0.000 0.017 0.051 0.1520.457 1.370 4.11112.333  
 37.000 111.000 333.000 growth () [ Absorbance ] at 650nm0.053 0.053 0.053 0.050 0.049  
 0.047 0.0420.027 0.027 0.029 0.1334-Nitroquinoline-N-oxide 0.000 0.001 0.003 0.008  
 0.0230.0700.210 0.630 1.8895.667 17.000 growth Concentration (muM) () [ Absorbance ] at  
 650nm0.066 0.061 0.059 0.056 0.055 0.054 0.0480.047 0.043 0.036 0.030Benzo(es)(a)  
 pyrene Concentration (muM) 0.000 0.017 0.051 0.152 0.457 1.370 4.11112.333 37.000  
 111.000 333.000 growth () [ Absorbance ] at 650nm0.055 0.053 0.058 0.058 0.054 0.049  
 0.0450.042 0.035 0.0260.019Paraquat Concentration (muM) 0.000 0.051 0.152 0.457 1.372  
 4.115 12.346 37.037111.111 333.333 -- 1000.000 growth (Absorbance at 650nm) 0.053  
 0.051 0.054 0.055 0.054 0.054 0.0510.049 0.052 0.046 0.041Maneb Concentration (muM)  
 0.000 0.017 0.051 0.152 0.457 1.370 4.111 12.333 37.000111.000 333.000 growth  
 (Absorbance at 650nm) -- 0.057 0.050 0.050 0.051 0.050 0.047 0.0440.042 0.032 0.025 0.030  
 Cadmium chloride Concentration (muM) 0.000 0.017 0.051 0.152 0.457 1.370 4.11112.333  
 37.000 111.000 333.000 growth (Absorbance at 650nm) 0.045 0.043 0.042 0.037 0.033 0.033  
 0.0330.031 0.029 0.029 0.027 Bis-phenol-A Concentration (muM) 0.000 0.169 0.508 1.524  
 4.572 13.716 41.148123.444 370.333 1111. 000 3333. 000 growth () [ Absorbance ] at  
 650nm0.060 0.058 0.062 0.064 0.059 0.055 0.0520.042 0.030 0.026 0.058Di(s)-2-ethylhexyl  
 phthalate Concentration (muM) 0.000 0.042 0.127 0.381 1.143 3.42810.284 30.852 92.556  
 277.667833.000 growth () [ Absorbance ] at 650nm0.052 0.052 0.053 0.051 0.053 0.051  
 0.0500.039 0.036 0.022 0. 0202 and 5-Dichlorophenol Concentration (muM) 0.000 0.169  
 0.508 -- 1.524 4.572 13.71641.148 123.444 370.333 1111.000 3333.000 growth (Absorbance  
 at 650nm) 0.062 0.059 0.061 0.060 0.059 0.056 0.0540.044 0.030 0.024 0.0202 and 4-  
 Dichlorophenoxy acetic acid Concentration (muM) 0.000 0.339 1.016 3.048 9.14427.432  
 82.296 246.889 740.667 -- 2222.000 6666.000 growth (Absorbance at 650nm) 0.062 0.058  
 0.063 0.061 0.057 0.055 0.0520.050 0.033 0.022 0.026Formaldehyde Concentration (muM)  
 0.000 0.085 0.254 0.762 2.285 6.856 20.56861.704 185.111 555.333 -- 1666.000 growth  
 (Absorbance at 650nm) 0.054 0.050 0.054 0.054 0.053 0.052 0.0510.050 0.048 0.036 0.021  
 p-Nonylphenol Concentration (muM) 0.000 0.034 0.102 0.305 0.914 2.741 8.22224.667  
 74.000 222.000 666.000 growth () [ Absorbance ] at 650nm0.056 0.054 0.052 0.052  
 0.0480.045 0.0310.021 0.019 0.023 0.069Sodium Arsenite Concentration (muM) 0.000 0.017  
 0.051 0.152 0.457 1.370 4.11112.333 37.000 111.000 333.000 growth () [ Absorbance ] at  
 650nm0.049 0.047 0.049 0.047 0.047 0.045 0.0440.040 0.040 0.0410.035Thiuram  
 Concentration (muM) 0.000 0.017 0.051 0.152 0.457 1.370 4.111 12.33337.000 111.000  
 333.000 growth () [ Absorbance ] at 650nm0.053 0.048 0.049 0.047 0.044 0.042 0.0340.028  
 0.023 0.022 0. 0252, 4, and 5-Trichlorophenol Concentration (muM) 0.000 0.169 0.508 1.524  
 4.572 13.71641.148 123.444 370.333 1111.000 3333. 000 growth () [ Absorbance ] at  
 650nm0.056 0.053 0.053 0.050 0.039 0.033 0.0310.0290.031 0.030 0.046 Potassium  
 dichlomite Concentration (muM) 0.000 0.002 0.005 0.0150.045 0.1360.407 1.222 3.667  
 11.000 33.000 growth (Absorbance at 650nm) 0.041 0.0360.041 0.043 0.043 0.043  
 0.0440.042 0.040 0.037 0.037Triphenyltin chloride Concentration (muM) 0.000 0.0000.001  
 0.002 0.005 0.0140.041 0.122 0.367 1.100 3.300 growth (Absorbance at650nm) -- 0.044  
 0.045 0.049 0.049 0.049 0.052 0.0500.044 0.034 0.026 -- 0.020 [0014]

[Table 4] (4) Chemical susceptibility Methylmercury chloride of *Aureobacterium* esteraromatium IFO 3752 Concentration (μM) 0.000 0.034 0.102 0.305 0.914 2.7418.222 24.667 74.000 222.000 666.000 growth (Absorbance at 650nm) 0.091 0.107 0.110 0.093 0.043 0.023 0.0220.023 0.022 0.021 0.018Nickel chloride Concentration (μM) 0.000 0.169 0.508 1.524 4.572 13.716 41.148123.444 370.333 1111. 000 3333. 000 growth () [ Absorbance ] at 650nm0.098 0.106 0.116 0.112 0.116 0.111 0.1120.114 0.110 0.084 0.0162-Aminoanthracene Concentration (μM) 0.000 0.169 0.508 1.524 4.572 13.716 41.148123.444 370.333 1111. -- 000 3333 .000 growth (Absorbance at 650nm) 0.095 0.093 0.113 0.104 0.099 0.099 0.0900.091 0.069 0.008-0.108Tributyltin chloride Concentration (μM) 0.000 0.003 0.010 0.030 0.091 0.2720.815 2.444 7.333 22.000 66.000 growth () [ Absorbance ] at 650nm0.105 0.037 0.044 0.044 0.042 0.038 0.0300.018 0.014 0.023 0.032Malathion(s) Concentration (μM) 0.000 0.034 0.102 0.305 0.914 2.741 8.222 24.66774.000 222.000 666.000 growth (Absorbanceat 650nm) 0.101 0.098 0.122 0.120 0.119 0.113 0.1050.100 0.088 0.068 - 0.001Phenol Concentration (μM) 0.000 0.847 2.540 7.620 22.86168.584 205.753 617.2591851.778 5555.333 16666. 000 growth () [ Absorbance ] at 650nm0.100 0.099 0.121 0.114 0.107 0.105 0.1010.098 0.085 0.045 0.023Lindane(s) Concentration (μM) 0.000 0.339 1.016 3.048 9.144 27.432 82.296 246.889740.667 2222.000 6666. 000 growth () [ Absorbance ] at 650nm0.103 0.1100.131 0.132 0.126 0.099 0.0770.093 0.103 0.111-0.059Pentachlorophenol concentration (μM) 0.000 0.034 0.102 0.305 0.914 2.741 8.22224.667 74.000 222.000 666.000 growth () [ Absorbance ] at 650nm0.095 0.098 0.116 0.115 0.093 0.054 0.0220.021 0.019 0.017 0.021 Trp-P -2 (Acetate) Concentration (μM) 0.000 0.017 0.051 0.152 0.457 1.370 4.11112.333 37.000 111.000 333.000 growth (Absorbance at 650nm) 0.089 0.098 0.107 0.107 0.103 0.089 0.0560.039 0.030 0.023 0.0564-Nitroquinoline-N-oxide Concentration (μM) 0.000 0.001 0.003 0.008 0.0230.0700.210 0.630 1.8895.667 17.000 growth () [ Absorbanceat ] 650nm0.106 0.111 0.121 0.118 0.118 0.118 0.1010.096 0.081 0.068 0.066Benzo(a) pyrene Concentration (μM) 0.000 0.017 0.051 0.152 0.457 1.370 4.11112.333 37.000 111.000 333.000 growth () [ Absorbance ] at 650nm0.096 0.097 0.118 0.117 0.113 0.110 0.1070.099 0.087 0.077 0.126Paraquat(s) Concentration (μM) 0.0000.051 0.152 0.457 1.372 4.11512.346 37.037111.111 333.333 1000.000 growth (Absorbance at 650nm) 0.097 0.089 0.120 0.117 0.112 0.104 0.0890.085 0.065 0.049 0.032Maneb Concentration (μM) 0.000 0.017 0.051 0.152 0.457 1.370 4.111 12.333 37.000111 . 000 333.000 growth () [ Absorbance ] at 650nm0.107 0.102 0.121 0.120 0.122 0.119 0.1160.105 0.074 0.024 0.036Cadmium chloride Concentration (μM) 0.000 0.017 0.051 0.152 0.457 1.370 4.11112.333 37.000 111.000 333.000 growth () [ Absorbance ] at 650nm0.090 0.094 0.119 0.119 0.112 0.105 0.0930.085 0.046 0.020 0.020 Bis-phenol-A Concentration (μM) 0.000 0.169 0.5081.524 4.572 13.716 41.148123.444 370.333 -- 1111.000 3333.000 growth (Absorbance at 650nm) 0.088 0.092 0.123 0.123 0.121 0.111 0.0950.080 0.019 0.018 0.052Di-2-ethylhexyl phthalate Concentration (μM) 0.000 0.042 0.127 0.381 1.143 3.42810.284 30.852 92.556 277.667 833.000 growth () [ Absorbance ] at 650nm0.087 0.069 0.122 0.119 0.121 0.117 0.1090.096 0.075 0.052 0. 0482 and 5-Dichlorophenol Concentration (μM) 0.000 0.169 0.508 -- 1.524 4.572 13.71641.148 123.444 370.333 1111.000 3333.000 growth (Absorbance at 650nm) 0.097 0.103 0.129 0.127 0.128 0.122 0.1130.086 0.020 0.017 0.0192 and 4-Dichlorophenoxy acetic acid Concentration (μM) 0.000 0.339 1.016 3.048 9.14427.432 82.296 246.889 740.667 -- 2222.000 6666.000 growth (Absorbance at 650nm) 0.093 0.103 0.124 0.122 0.124 0.124 0.1160.100 0.075 0.018 0.027Formaldehyde Concentration (μM) 0.000 0.085 0.254 0.762 2.285 6.856 20.56861.704 185.111 555.333 -- 1666.000 growth (Absorbance at 650nm) 0.097 0.107 0.122 0.123 0.119 0.121 0.1200.112 0.084 0.044 0.015 p-Nonylphenol Concentration (μM) 0.000 0.034 0.102 0.305 0.914 2.741 8.22224.667 74.000 222.000 666.000 growth () [ Absorbance ] at 650nm0.102 0.090 0.076 0.111 0.1080.095 0.0150.016 0.013 0.022 0.101Sodium Arsenite Concentration (μM) 0.000 0.017 0.051 0.152 0.457

1.370 4.11112.333 37.000 111.000 333.000 growth () [ Absorbance ] at 650nm0.098 0.094  
 0.122 0.120 0.119 0.119 0.1110.107 0.100 0.0880.065Thiuram Concentration (muM) 0.000  
 0.017 0.051 0.152 0.457 1.370 4.111 12.33337.000 111.000 333.000 growth ()  
 [ Absorbance ] at 650nm0.105 0.097 0.124 0.122 0.123 0.109 0.0820.040 0.020 0.017 0.  
 0162, 4, and 5-Trichlorophenol Concentration (muM) 0.000 0.169 0.508 1.524 4.572  
 13.71641.148 123.444 370.333 1111.000 3333. 000 growth () [ Absorbance ] at 650nm0.098  
 0.095 0.115 0.110 0.081 0.021 0.0200.0200.020 0.023 0.033 Potassium dichlomite  
 Concentration (muM) 0.000 0.002 0.005 0.0150.045 0.1360.407 1.222 3.667 11.000 33.000  
 growth (Absorbance at 650nm) 0.105 0.1010.121 0.122 0.124 0.117 0.1180.120 0.116 0.109  
 0.088Triphenyltin chloride Concentration (muM) 0.000 0.0000.001 0.002 0.005 0.0140.041  
 0.122 0.367 1.100 3.300 growth (Absorbance at650nm) -- 0.100 0.096 0.107 0.110 0.109  
 0.103 0.1000.085 0.056 0.029 -- 0.019 [0015]  
 [Table 5] (5) Comamonas Testosteroni The chemical susceptibility Methylmercury of  
 IAM1048 chloride Concentration (muM) 0.000 0.034 0.102 0.305 0.914 2.7418.222 24.667  
 74.000 222.000 666.000 growth () [ Absorbance ] at 650nm0.420 0.419 0.417 0.381 0.080  
 0.059 0.0560.056 0.057 0.048 0.039Nickel chloride Concentration (muM) 0.000 0.169 0.508  
 1.524 4.572 13.716 41.148123.444370. [333 ] 1111. 000 3333. 000 growth () [ Absorbance ]  
 at 650nm0.316 0.302 0.314 0.3130.303 0.302 0.2930.285 0.279 0.178 - 0.0052-  
 Aminoanthracene Concentration (muM) 0.000 0.169 0.508 1.524 4.572 13.716  
 41.148123.444 370.333 1111. -- 000 3333 .000 growth (Absorbance at 650nm) 0.417 0.412  
 0.435 0.420 0.425 0.413 0.3900.335 0.248 0.118-0.084Tributyltin chloride Concentration  
 (muM) 0.000 0.003 0.010 0.0300.091 0.2720.815 2.444 7.333 22.000 66.000 growth ()  
 [ Absorbance ] at 650nm0.401 0.406 0.401 0.394 0.373 0.268 0.1550.074 0.056 0.051  
 0.072Malathion(s) Concentration (muM) 0.000 0.034 0.102 0.305 0.914 2.741 8.222  
 24.66774.000 222.000 666.000 growth (Absorbance at 650nm) 0.341 0.341 0.346 0.319  
 0.314 0.300 0.2880.270 0.234 0.141 - 0.101Phenol Concentration (muM) 0.0000.847 2.540  
 7.620 22.86168.584 205.753 617.2591851.778 5555.333 16666. 000 growth ()  
 [ Absorbance ] at 650nm0.321 0.302 0.312 0.315 0.319 0.321 0.3050.302 0.269 0.156  
 0.000Lindane(s) Concentration (muM) 0.000 0.339 1.016 3.0489.144 27.432 82.296  
 246.889740.667 2222. 000 6666. 000 growth () [ Absorbance ] at 650nm0.323 0.312 0.316  
 0.313 0.302 0.267 0.2400.258 0.405 0.750 1.157Pentachlorophenol(s) Concentration (muM)  
 0.000 0.034 0.102 0.305 0.914 2.741 8.22224.667 74.000 222.000 666.000 growth ()  
 [ Absorbance ] at 650nm0.393 0.404 0.401 0.400 0.379 0.337 0.2820.158 0.039 0.035 0.037  
 Trp-P -2 (Acetate) Concentration (muM) 0.000 0.017 0.051 0.152 0.457 1.3704.11112.333  
 37.000 111.000 333.000 growth (Absorbance at 650nm) 0.391 0.562 0.456 0.411 0.418 0.361  
 0.2670.089 0.046 0.035 0.0894-Nitroquinoline-N-oxide Concentration (muM) 0.000 0.001  
 0.003 0.008 0.0230.0700.210 0.630 1.8895.667 17.000 growth () [ Absorbance ] at  
 650nm0.399 0.406 0.412 0.398 0.402 0.386 0.3660.355 0.345 0.284 0.140Benzo(es)(a)  
 pyrene Concentration (muM) 0.000 0.017 0.051 0.152 0.457 1.370 4.11112.333 37.000  
 111.000 333.000 growth () [ Absorbance ] at 650nm0.416 0.425 0.445 0.443 0.432 0.430  
 0.4250.409 0.386 0.306-0.108Paraquat Concentration (muM) 0.000 0.051 0.152 0.457 1.372  
 4.115 12.346 37.037111.111 333.333 -- 1000.000 growth (Absorbance at 650nm) 0.327  
 0.314 0.326 0.313 0.304 0.294 0.2590.168-0.085-0.543 - 1.517Maneb Concentration (muM)  
 0.000 0.017 0.051 0.152 0.457 1.370 4.111 12.333 37.000111.000 333.000 growth  
 (Absorbance at 650nm) -- 0.316 0.304 0.314 0.311 0.304 0.303 0.2840.257 0.165 0.041  
 0.003Cadmium chloride Concentration (muM) 0.000 0.017 0.051 0.152 0.457 1.370  
 4.11112.333 37.000 111.000 333.000 growth () [ Absorbance ] at 650nm0.307 0.294 0.302  
 0.294 0.287 0.297 0.2860.262 0.201 0.068 - 0.269 Bis-phenol-A Concentration (muM) 0.000  
 0.169 0.508 1.524 4.572 13.716 41.148123.444 370.333 1111.000 3333.000 growth  
 (Absorbance at 650nm) 0.413 0.420 0.425 0.428 0.423 0.388 0.3530.223 0.054 0.049  
 0.157Di-2-ethylhexyl phthalate Concentration (muM) 0.000 0.042 0.127 0.381 1.143

3.42810.284 30.852 92.556 277.667 833.000 growth () [ Absorbance ] at 650nm0.432 0.414  
 0.440 0.437 0.438 0.426 0.4360.417 0.110 0.021 - 0.1432 and 5-Dichlorophenol  
 Concentration (muM) 0.000 0.1690.508 1.524 4.572 13.71641.148 123.444 370.333  
 1111.000 3333. 000 growth () [ Absorbance ] at 650nm0.436 0.442 0.447 0.449 0.454 0.430  
 0.1340.083 0.054 0.049 0. 0402 and 4-Dichlorophenoxy acetic acid Concentration (muM)  
 0.000 0.339 1.016 3.048 9.14427.432 82.296 246.889 740.667 2222.000 6666.000 growth  
 (Absorbance at 650nm) 0.427 0.430 0.438 0.443 0.446 0.4340.4210.390 0.099  
 0.0440.052Formaldehyde(s) Concentration (muM) 0.000 0.085 0.254 0.762 2.285 6.856  
 20.56861.704 185.111 555.333 -- 1666.000 growth (Absorbance at 650nm) 0.437 0.428  
 0.444 0.446 0.442 0.427 0.4330.429 0.430 0.382 0.077 p-Nonylphenol Concentration (muM)  
 0.000 0.034 0.102 0.305 0.914 2.7418.22224.667 74.000 222.000 666.000 growth  
 (Absorbance at 650nm) 0.403 0.387 0.412 0.408 0.388 0.364 0.2930.216 0.182 0.142  
 0.022Sodium Arsenite Concentration (muM) 0.000 0.017 0.051 0.152 0.457 1.370  
 4.11112.333 37.000 111.000 333.000 growth () [ Absorbance ] at 650nm0.407 0.407 0.403  
 0.436 0.416 0.399 0.3830.365 0.333 0.242 0.129Thiuram(s) Concentration (muM) 0.000  
 0.0170.051 0.152 0.457 1.3704.111 12.33337.000 111.000 333.000 growth (Absorbanceat  
 650nm) 0.404 0.401 0.426 0.416 0.391 0.362 0.2530.191 0.083 0.037 0. 0472, 4, and 5-  
 Trichlorophenol Concentration (muM) 0.000 0.169 0.508 -- 1.524 4.572 13.71641.148  
 123.444 370.333 1111.000 3333.000 growth (Absorbance at 650nm) 0.411 0.398 0.397 0.390  
 0.313 0.063 0.0500.052 0.049 0.041 0.077Potassium dichlomite Concentration (muM) 0.000  
 0.002 0.005 0.015 0.045 0.1360.407 1.222 3.667 11.000 33.000 growth () [ Absorbance ] at  
 650nm0.323 0.303 0.322 0.318 0.311 0.303 0.2960.296 0.289 0.273 0.226 Triphenyltin  
 chloride Concentration (muM) 0.000 0.000 0.001 0.002 0.005 0.0140.041 0.1220.367 1.100  
 3.300 growth (Absorbance at 650nm) -- 0.321 0.315 0.328 0.327 0.317 0.304 0.2820.280  
 0.237 -- 0.1970.118 [0016]  
 [Table 6] (6) *Pseudomonas synxantha* Chemical susceptibility Methylmercury chloride of  
 IFO 3913 Concentration (muM) 0.000 0.034 0.102 0.305 0.914 2.7418.222 24.667 74.000  
 222.000 666.000 growth () [ Absorbance ] at 650nm0.719 0.716 0.728 0.733 0.736 0.476  
 0.0700.060 0.056 0.057 0.046Nickel chloride Concentration (muM) 0.000 0.169 0.508 1.524  
 4.572 13.716 41.148123.444 370.333 1111. 000 3333. 000 growth () [ Absorbance ] at  
 650nm0.667 0.686 0.673 0.673 0.673 0.666 0.6620.666 0.659 0.542 0.0512-  
 Aminoanthracene Concentration (muM) 0.000 0.169 0.508 1.524 4.572 13.716  
 41.148123.444 370.333 1111.000 -- 3333.000 growth (Absorbance at 650nm) 0.784 0.785  
 0.804 0.794 0.805 0.803 0.7690.723 0.682 0.548 0.150Tributyltin chloride Concentration  
 (muM) 0.000 0.003 0.010 0.030 0.091 0.2720.815 2.444 7.333 22.000 66.000 growth ()  
 [ Absorbance ] at 650nm0.748 0.773 0.767 0.776 0.769 0.761 0.7610.729 0.351 0.077  
 0.057Malathion(s) Concentration (muM) 0.000 0.034 0.102 0.305 0.914 2.741 8.222  
 24.66774.000 222.000 666.000 growth (Absorbanceat 650nm) 0.717 0.714 0.708 0.696 0.695  
 0.680 0.6880.706 0.778 0.751 0.180Phenol(s) Concentration (muM) 0.000 0.847 2.540 7.620  
 22.861 68.584 205.753 617.2591851.778 5555.333 16666. 000 growth () [ Absorbance ] at  
 650nm0.624 0.649 0.646 0.615 0.594 0.541 0.4220.298 0.203 0.116 0.053Lindane(s)  
 Concentration (muM) 0.000 0.339 1.016 3.048 9.144 27.432 82.296 246.889740.667  
 2222.000 6666. 000 growth () [ Absorbanceat ] 650nm0.655 0.657 0.647 0.660 0.644 0.606  
 0.5930.597 0.571 0.451-0.032Pentachlorophenol concentration (muM) 0.000 0.034 0.102  
 0.305 0.914 2.741 8.22224.667 74.000 222.000 666.000 growth () [ Absorbance ] at  
 650nm0.770 0.775 0.774 0.763 0.756 0.726 0.7110.692 0.708 0.7310.158 Trp-P -2 (Acetate)  
 Concentration (muM) 0.000 0.017 0.051 0.152 0.457 1.370 4.11112.333 37.000 111.000  
 333.000 growth () [ Absorbance ] at 650nm0.701 0.712 0.726 0.723 0.723 0.714 0.7110.730  
 0.700 0.382 0.1494-Nitroquinoline-N-oxide 0.000 0.001 0.003 0.008 0.023 0.0700.210 0.630  
 1.889 5.667 17.000 growth Concentration (muM) () [ Absorbance ] at 650nm0.746 0.754  
 0.768 0.748 0.753 0.741 0.7180.725 0.747 0.845 0.630Benzo(es)(a) pyrene Concentration

( $\mu\text{M}$ ) 0.000 0.017 0.051 0.152 0.457 1.370 4.111 12.333 37.000 111.000 333.000 growth (Absorbance at 650nm) 0.782 0.802 0.814 0.819 0.803 0.806 0.793 0.775 0.773 0.774 0.558

Paraquat Concentration ( $\mu\text{M}$ ) 0.000 0.051 0.152 0.457 1.372 4.115 12.346 37.037 111.111 333.333 -- 1000.000 growth (Absorbance at 650nm) 0.680 0.691 0.679 0.669 0.659 0.638 0.555 0.440 0.308 0.221 0.154

Maneb Concentration ( $\mu\text{M}$ ) 0.000 0.017 0.051 0.152 0.457 1.370 4.111 12.333 37.000 111.000 333.000 -- growth (Absorbance at 650nm) 0.695 0.720 0.712 0.697 0.676 0.668 0.669 0.692 0.760 0.808 0.261

Cadmium chloride Concentration ( $\mu\text{M}$ ) 0.000 0.017 0.051 0.152 0.457 1.370 4.111 12.333 37.000 111.000 333.000 growth (Absorbance at 650nm) 0.677 0.704 0.696 0.698 0.683 0.676 0.648 0.592 0.529 0.471 0.381

Bis-phenol-A Concentration ( $\mu\text{M}$ ) 0.000 0.169 0.508 1.524 4.572 13.716 41.148 123.444 370.333 1111.000 3333.000 growth (Absorbance at 650nm) -- 0.787 0.805 0.812 0.817 0.821 0.807 0.821 0.836 0.573 0.686 0.455

Di-2-ethylhexyl phthalate Concentration ( $\mu\text{M}$ ) 0.000 0.042 0.127 0.381 1.143 3.428 10.284 30.852 92.556 277.667 833.000 growth () [ Absorbance ] at 650nm 0.784 0.757 0.792 0.794 0.783 0.772 0.773 0.772 0.788 0.783 0.582

and 5-Dichlorophenol Concentration ( $\mu\text{M}$ ) 0.000 0.169 0.508 -- 1.524 4.572 13.716 41.148 123.444 370.333 1111.000 3333.000 growth (Absorbance at 650nm) 0.788 0.805 0.810 0.818 0.822 0.824 0.830 0.852 0.767 0.075 0.024

and 4-Dichlorophenoxy acetic acid Concentration ( $\mu\text{M}$ ) 0.000 0.339 1.016 3.048 9.144 27.432 82.296 246.889 740.667 -- 2222.000 6666.000 growth (Absorbance at 650nm) 0.761 0.773 0.785 0.797 0.801 0.795 0.801 0.835 0.906 0.945 0.045

Formaldehyde Concentration ( $\mu\text{M}$ ) 0.000 0.085 0.254 0.762 2.285 6.856 20.568 61.704 185.111 555.333 -- 1666.000 growth (Absorbance at 650nm) 0.765 0.752 0.776 0.784 0.785 0.779 0.789 0.789 0.784 0.765 0.740

p-Nonylphenol Concentration ( $\mu\text{M}$ ) 0.000 0.034 0.102 0.305 0.914 2.741 8.222 24.667 74.000 222.000 666.000 growth () [ Absorbance ] at 650nm 0.758 0.762 0.775 0.763 0.737 0.708 0.726 0.621 0.484 0.420 0.289

Sodium Arsenite Concentration ( $\mu\text{M}$ ) 0.000 0.017 0.051 0.152 0.457 1.370 4.111 12.333 37.000 111.000 333.000 growth () [ Absorbance ] at 650nm 0.776 0.773 0.786 0.778 0.762 0.735 0.715 0.680 0.663 0.615 0.520

Thiuram Concentration ( $\mu\text{M}$ ) 0.000 0.017 0.051 0.152 0.457 1.370 4.111 12.333 37.000 111.000 333.000 growth () [ Absorbance ] at 650nm 0.769 0.773 0.774 0.771 0.773 0.756 0.737 0.703 0.652 0.624 0.354

2, 4, and 5-Trichlorophenol Concentration ( $\mu\text{M}$ ) 0.000 0.169 0.508 1.524 4.572 13.716 41.148 123.444 370.333 1111.000 3333.000 growth () [ Absorbance ] at 650nm 0.750 0.759 0.763 0.759 0.736 0.701 0.657 0.562 0.044 0.033 0.081

Potassium dichromate Concentration ( $\mu\text{M}$ ) 0.000 0.002 0.005 0.015 0.045 0.136 0.407 1.222 3.667 11.000 33.000 growth (Absorbance at 650nm) 0.644 0.664 0.668 0.659 0.651 0.631 0.636 0.634 0.630 0.602 0.501

Triphenyltin chloride Concentration ( $\mu\text{M}$ ) 0.000 0.000 0.001 0.002 0.005 0.014 0.041 0.122 0.367 1.100 3.300 growth (Absorbance at 650nm) -- 0.624 0.631 0.621 0.636 0.635 0.622 0.621 0.641 0.672 0.738 -- 0.418 [0017]

[Table 7] (7) Staphylococcus aureus Chemical susceptibility Methylmercury chloride of IFO 3060 Concentration ( $\mu\text{M}$ ) 0.000 0.034 0.102 0.305 0.914 2.741 8.222 24.667 74.000 222.000 666.000 growth () [ Absorbance ] at 650nm 0.184 0.198 0.200 0.189 0.007 0.006 0.006 0.007 0.008 0.007 0.005

Nickel chloride Concentration ( $\mu\text{M}$ ) 0.000 0.169 0.508 1.524 4.572 13.716 41.148 123.444 370.333 1111.000 3333.000 growth () [ Absorbance ] at 650nm 0.237 0.232 0.226 0.227 0.224 0.220 0.216 0.216 0.208 0.111 0.007

2-Aminoanthracene Concentration ( $\mu\text{M}$ ) 0.000 0.169 0.508 1.524 4.572 13.716 41.148 123.444 370.333 1111.000 -- 3333.000 growth (Absorbance at 650nm) 0.174 0.181 0.176 0.173 0.170 0.168 0.167 0.155 0.124 0.121 0.033

Tributyltin chloride Concentration ( $\mu\text{M}$ ) 0.000 0.003 0.010 0.030 0.091 0.272 0.815 2.444 7.333 22.000 66.000 growth () [ Absorbance ] at 650nm 0.154 0.177 0.185 0.183 0.160 0.109 0.085 0.045 0.020 0.010 0.029

Malathion(s) Concentration ( $\mu\text{M}$ ) 0.000 0.034 0.102 0.305 0.914 2.741 8.222 24.667 74.000 222.000 666.000 growth (Absorbance at 650nm) 0.235 0.226 0.223 0.219 0.216 0.211 0.215 0.222 0.231 0.226 0.063

Phenol(s) Concentration ( $\mu\text{M}$ ) 0.000 0.847 2.540 7.620

22.861 68.584 205.753 617.2591851.778 5555.333 16666.000 growth () [ Absorbance ] at  
 650nm0.256 0.192 0.199 0.198 0.197 0.193 0.1930.190 0.180 0.159 0.043Lindane(s)  
 Concentration (muM) 0.000 0.339 1.016 3.048 9.144 27.432 82.296 246.889740.667  
 2222.000 6666.000 growth () [ Absorbanceat ] 650nm0.177 0.095 0.085 0.080 0.075 0.071  
 0.0800.074 0.106 0.055-0.230Pentachlorophenol concentration (muM) 0.000 0.034 0.102  
 0.305 0.914 2.741 8.22224.667 74.000 222.000 666.000 growth () [ Absorbance ] at  
 650nm0.146 0.148 0.142 0.129 0.107 0.090 0.0730.041 0.007 0.0020.004 Trp-P -2 (Acetate)  
 Concentration (muM) 0.000 0.017 0.051 0.152 0.457 1.370 4.11112.333 37.000 111.000  
 333.000 growth () [ Absorbance ] at 650nm0.189 0.200 0.199 0.187 0.176 0.143 0.0840.041  
 0.017 0.012 0.0854-Nitroquinoline-N-oxide 0.000 0.001 0.003 0.008 0.023 0.0700.210 0.630  
 1.889 5.667 17.000 growth Concentration (muM) () [ Absorbance ] at 650nm0.182 0.185  
 0.185 0.183 0.181 0.177 0.1850.188 0.191 0.170 0.104Benzo(es)(a) pyrene Concentration  
 (muM) 0.000 0.017 0.051 0.152 0.457 1.3704.11112.333 37.000 111.000 333.000 growth  
 (Absorbance at 650nm) 0.162 0.164 0.156 0.158 0.138 0.114 0.0940.076 0.068 0.062  
 0.094Paraquat Concentration (muM) 0.000 0.051 0.152 0.457 1.372 4.115 12.346  
 37.037111.111 333.333 -- 1000.000 growth (Absorbance at 650nm) 0.249 0.241 0.218 0.217  
 0.217 0.211 0.1960.177 0.174 0.175 0.161Maneb Concentration (muM) 0.000 0.017  
 0.0510.152 0.457 1.370 4.11112.333 37.000111.000 333.000 growth () [ Absorbance ] at  
 650nm0.232 0.230 0.225 0.226 0.223 0.215 0.2160.212 0.187 0.134 0.013Cadmium chloride  
 Concentration (muM) 0.000 0.017 0.051 0.152 0.457 1.370 4.11112.333 37.000 111.000 33  
 3.000 growth () [ Absorbance at ] 650nm0.237 0.233 0.221 0.215 0.203 0.164 0.1590.123  
 0.090 0.076 0.029 Bis-phenol-A Concentration (muM) 0.000 0.169 0.508 1.524 4.572 13.716  
 41.148123.444 370.333 1111.000 3333.000 growth () [ Absorbance ] at 650nm0.159 0.158  
 0.156 0.156 0.158 0.1630.1620.109 0.003 0.0030.085Di-2-ethylhexyl phthalate  
 Concentration (muM) 0.000 0.042 0.127 0.381 1.143 3.42810.284 30.852 92.556 277.667  
 833.000 growth () [ Absorbance ] at 650nm0.158 0.157 0.159 0.152 0.153 0.150 0.1510.153  
 0.143 0.080 0.0692 and 5-Dichlorophenol Concentration (muM) 0.000 0.169 0.508 1.524  
 4.572 13.71641.148 123.444 370.333 1111.000 3333.000 growth (Absorbance at 650nm)  
 0.1560.162 0.158 0.157 0.156 0.152 0.0860.053 0.029 0.001 0.0022, 4-Dichlorophenoxy  
 acetic acid concentration (muM) 0.000 0.339 1.016 3.048 9.14427.432 82.296 246.889  
 740.667 -- 2222.000 6666.000 growth (Absorbance at 650nm) 0.158 0.159 0.155 0.159 0.159  
 0.153 0.1460.116 0.066 0.005 0.011Formaldehyde Concentration (muM) 0.000 0.085 0.254  
 0.762 2.285 6.856 20.56861.704 185.111 555.333 -- 1666.000 growth (Absorbance at  
 650nm) 0.160 0.159 0.163 0.164 0.162 0.161 0.1590.161 0.160 0.156 0.147 p-Nonylphenol  
 Concentration (muM) 0.000 0.034 0.102 0.305 0.914 2.741 8.22224.667 74.000 222.000  
 666.000 growth () [ Absorbance ] at 650nm0.158 0.165 0.164 0.167 0.1430.156 0.0700.068  
 0.052 0.055 0.160Sodium Arsenite Concentration (muM) 0.000 0.017 0.051 0.152 0.457  
 1.370 4.11112.333 37.000 111.000 333.000 growth () [ Absorbance ] at 650nm0.148 0.148  
 0.148 0.147 0.149 0.143 0.1410.131 0.094 0.0940.070Thiuram Concentration (muM) 0.000  
 0.017 0.051 0.152 0.457 1.370 4.111 12.33337.000 111.000 333.000 growth ()  
 [ Absorbance ] at 650nm0.145 0.150 0.150 0.153 0.151 0.146 0.1340.092 0.029 0.006 0.  
 0042, 4, and 5-Trichlorophenol Concentration (muM) 0.000 0.169 0.508 1.524 4.572  
 13.71641.148 123.444 370.333 1111.000 3333.000 growth () [ Absorbance ] at 650nm0.152  
 0.155 0.161 0.154 0.109 0.034 0.0060.0050.005 0.006 0.000 Potassium dichlomite  
 Concentration (muM) 0.000 0.002 0.005 0.0150.045 0.1360.407 1.222 3.667 11.000 33.000  
 growth (Absorbance at 650nm) 0.241 0.2270.225 0.224 0.220 0.216 0.2190.222 0.218 0.207  
 0.188Triphenyltin chloride Concentration (muM) 0.000 0.0000.001 0.002 0.005 0.0140.041  
 0.122 0.367 1.100 3.300 growth (Absorbance at650nm) -- 0.256 0.274 0.260 0.257 0.255  
 0.254 0.2480.232 0.129 0.097 -- 0.024 [0018] It is desirable to choose many things from  
 which the class which is easy to receive growth inhibition differed as an index microorganism.  
 It is good to select the indispensable index microorganism to each chemical as such a

microorganism. In order to select this indispensable index microorganism, first, the least concentration which checks growth of that *Escherichia coli* is measured about each chemical, and the multiple selection of the microorganism which receives growth inhibition from this minimum inhibition concentration by low concentration is made (primary screening). Next, the microorganism chosen by this primary screening is grown under existence of the index chemical of different concentration, and the property of the growth inhibition by that chemical is observed. The microorganism which shows susceptibility most to that chemical in the microorganism chosen by primary screening is chosen from this result as an indispensable index microorganism. Of course, as an index microorganism, various kinds of microorganisms which are easy to receive growth inhibition from the *Escherichia coli* other than this indispensable index microorganism can be made into an index microorganism.

[0019] Index chemicals, such as Methylmercury chloride, Nickel chloride, 2-Aminoanthracene, Malathion, Phenol, and Lindane, have clearly remarkable inhibition of as opposed to an index microorganism except for Methylmercury chloride so that I may be understood from the result shown in said tables 1-7. However, about Methylmercury chloride and Tributyltin chloride, remarkable growth inhibition was accepted by two or more microorganisms besides the index microorganism. Although an almost comparable inhibition property is shown to all index microorganisms about Methylmercury chloride, since such a chemical is not accepted, it can be understood to be what shows the description of Methylmercury chloride by other 24 kinds. About Tributyltin chloride, since inhibition is shown only within three kinds of microorganisms, this can also be understood to be what the growth spectrum expresses the description of Tributyltin chloride to. The growth property or production spectrum (microorganism / chemical concentration data) of reflect [ the description of a chemical ] of an index microorganism to the above-mentioned chemical is clear from the above thing.

[0020] About Pentachlorophenol, Trp-P -2 (Acetate), 4-Nitroquinoline-N-oxide, Benzo(a) pyrene, Paraquat, Maneb, and Cadmium chloride, since the microorganism which shows susceptibility to these compounds exists, the growth spectrum is characteristic. For example, *Acetobacter pasteurianus* IF03129 showed susceptibility to Pentachlorophenol. Although this microorganism was originally selected as a microorganism which shows susceptibility to Nickel chloride, it can be understood that there is susceptibility also in Pentachlorophenol. However, since the susceptibility over other Pentachlorophenol(s) and Nickel chloride of a microorganism differs, it is shown that the growth spectrum is that from which both chemicals differ clearly. Although similarly the index microorganism which shows susceptibility exists also about Trp-P -2 (Acetate), 4-Nitroquinoline-N-oxide, Benzo(a) pyrene, Paraquat, Maneb, and Cadmium chloride, it is distinguishable from spectrums other than the microorganism concerned differing.

[0021] The microorganism which shows susceptibility notably did not exist about Bisphenol-A, Di-2-ethyl hexylphthalate, 2, 5-Dichlorophenol, 2, 4-Dichlorophenoxy acid, Formaldehyde, p-Nonylphenol, Sodium Arsenite, Thiuram, 2 and 4, 5-Trichlorophenol, Potassium dichromate, and Triphenyltin chloride. If 2, 5-Dichlorophenol and 2, 4-Dichlorophenoxy acetic acid, 2 and 4, and 5-Trichlorophenol are removed among these compounds, since the susceptibility of the microorganism to these compounds differs, the growth spectrum of a chemical has brought a characteristic result. About 2, 5-Dichlorophenol, 2, 4-Dichlorophenoxy acetic acid, 2 and 4, and 5-Trichlorophenol, the growth spectrum was similar. However, since these compounds are analogue, it is guessed that the toxicity is also similar and it can be considered to be natural that a growth spectrum is similar. On the contrary, in order that this invention method may express the toxicity of a chemical, it is possible that it is the example which shows the effective thing.

[0022] The approach of this invention includes the process which grows two or more index microorganisms in the bottom of existence of a sample chemical. The conditions for growth

in this case are the same conditions as the time of growing an index chemical under existence of the above mentioned index microorganism. Moreover, the approach of this invention includes the measurement process which measures the relation of the microorganism concentration and the nature concentration of a sample compound in said growth process. The approach of this invention includes the collating process which collates the microorganism / chemical concentration data obtained at said measurement process with the index microorganism / index chemical concentration data contained by said data bank. In this collating process, it is identified that that quality of a sample compound is identically [ to a sample chemical ] the same as that of the index chemical in that detected data microbiologically when the index microorganism / index chemical concentration data to approximate are detected, or the thing to approximate. The sample chemical which can be used for this invention does not need to be a high grade chemical, and can be the environmental water containing a chemical, polluted water polluted with the chemical. Each of each above mentioned processes can be performed automatically. Collating with the data contained by the data bank of the data obtained at the measurement process can be automatically performed using a computer.

[0023]

[Effect of the Invention] According to this invention, a sample chemical can be identified microbiologically. That is, the toxicity over the microorganism of the class and structure of the chemical, and its chemical can be known by the microbiological technique. Such an approach was not learned at all conventionally, but it was obtained for the first time by this invention, and the industrial meaning is great.

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[Translation done.]



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## (54) METHOD FOR MICROBIOLOGICALLY IDENTIFYING CHEMICAL SUBSTANCE

## (57)Abstract:

PROBLEM TO BE SOLVED: To provide a method for microbiologically identifying a sample chemical substance, because information for judging the property of toxicity or the kind of chemical substances causing the toxicity is not entirely afforded, though the bioassay utilized at present mainly measures only growth inhibition of unicell and the presence of the toxicity due to the chemical substances can be evaluated.

SOLUTION: This method for microbiologically identifying chemical substances features comprising a microorganism growth process for growing previously decided several kinds of marker microorganisms in the presence of the sample chemical substance under various concentrations of the sample chemical substance, a measurement process for measuring the relationship between the concentration of the sample chemical substance and the concentration of the marker microorganisms on the microorganism growth process and a comparison process for comparing the relationship between the concentration of the marker microorganisms and the concentration of the sample chemical substance obtained by the measurement process with the data showing the relationship between the concentration of a marker microorganism previously put away into a data bank and the concentration of a marker chemical substance.

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最終頁に続く

(54) 【発明の名称】 化学物質の微生物学的同定方法

(57) 【要約】

【課題】 試料化学物質を、微生物学的に同定する方法を提供する。

【解決手段】 あらかじめ定めた複数種の指標微生物を試料化学物質の存在下で該試料化学物質の濃度を変化させて生育させる微生物生育工程と、該微生物生育工程における試料化学物質濃度と指標微生物濃度との関係を測定する測定工程と、該測定工程で得られた該指標微生物濃度と該試料化学物質濃度との関係を、データベースにあらかじめ収納させている指標微生物濃度と指標化学物質濃度との関係を示すデータと照合する照合工程とからなることを特徴とする化学物質の微生物学的同定方法。

## 【特許請求の範囲】

【請求項1】 あらかじめ定めた複数種の指標微生物を試料化学物質の存在下で該試料化学物質の濃度を変化させて生育させる微生物生育工程と、該微生物生育工程における試料化学物質濃度と指標微生物濃度との関係を測定する測定工程と、該測定工程で得られた該指標微生物濃度と該試料化学物質濃度との関係を、データベースにあらかじめ収納させている指標微生物濃度と指標化学物質濃度との関係を示すデータと照合する照合工程とからなることを特徴とする化学物質の微生物学的同定方法。

## 【発明の詳細な説明】

## 【0001】

【発明の属する技術分野】本発明は、化学物質の微生物的同定方法に関するものである。

## 【0002】

【従来の技術】現在、化学物質のデータベースChemical abstractには約1700万種の化学物質が登録されている。そのうち、1万種類以上の合成化学物質が環境中に蓄積しているものと推定され、その数は年々増えている。合成化学物質の中には、直接または環境中で形を変えた後に生態や人体に悪影響を与える物質も含まれている。そのため、それぞれの化学物質について、生態や人体に与える影響を迅速に評価する必要がある。また、環境汚染問題が国民の不安をあおるような社会問題となっている状況の下、種々の高度な測定システムで、環境中に存在する化学物質を同定・定量しようとする試みがなされている。しかしながら、どのような高度な技術を用いても、現状では約10%の化学物質を同定できないと言われている。従って、環境中に存在する未知の化学物質そのものを同定するよりも、環境中に存在する化学物質の毒性を表現できる指標を確立する方が実用的である。上述した必要性から、現在、多機関で簡易毒性評価試験（バイオアッセイ）を利用した毒性の指標化がなされようとしている。バイオアッセイでは生物個体を用いず動植物細胞や微生物を用いて「化学物質による生物学的応答の変化」を測定し、「毒性」を評価する方法である。ところが、現在利用されているバイオアッセイは主として単一細胞の生育阻害を測定しているだけである。この方法では、化学物質による毒性の有無は評価できるが、その毒性の性質やどのような化学物質に起因する毒性であるかを判断するための情報が全く得られない。

## 【0003】

【発明が解決しようとする課題】本発明は、試料化学物質を、微生物学的に同定する方法を提供することをその課題とする。

## 【0004】

【課題を解決するための手段】本発明者らは、前記課題を解決すべく鋭意研究を重ねた結果、本発明を完成するに至った。即ち、本発明によれば、あらかじめ定めた複

数種の指標微生物を試料化学物質の存在下で該試料化学物質の濃度を変化させて生育させる微生物生育工程と、該微生物生育工程における試料化学物質濃度と指標微生物濃度との関係を測定する測定工程と、該測定工程で得られた該指標微生物濃度と該試料化学物質濃度との関係を、データベースにあらかじめ収納させている指標微生物濃度と指標化学物質濃度との関係を示すデータと照合する照合工程とからなることを特徴とする化学物質の微生物学的同定方法が提供される。

## 【0005】

【発明の実施の形態】本発明の方法は、その試料化学物質を微生物学的に同定するためのデータベースを用いる。このデータベースには、あらかじめ測定した指標化学物質濃度と指標微生物濃度との関係を示すデータを収納させておく。このデータベースに収納させる指標化学物質濃度と指標微生物濃度との関係を示すデータ（以下、単に微生物／化学物質濃度データとも言う）は、できるだけ多数であることが好ましく、その微生物／化学物質濃度データが新しく得られたときには、迅速にそのデータをデータベースに収納させるのが好ましい。本発明の場合、あらかじめ定めた複数種の指標微生物とあらかじめ定めた複数種の指標化学物質とを用いて、微生物／化学物質濃度データを作り、これをデータベースに収納させておくのがよい。

【0006】指標化学物質としては、微生物に対して阻害性を示すものが用いられる。このようなものとしては、以下に示す大腸菌に対する生育阻害性を示すものを選んだ。下記にした化合物の後のカッコ内に、大腸菌に対するその最低阻害濃度を示す。

【0007】No. 1 Methylmercury chloride (0.91 μM)

No. 2 Nickel chloride (1111 μM)

No. 3 2-Aminoanthracene (370 μM)

No. 4 Tributyltin chloride (0.1 μM)

No. 5 Malathion (222 μM)

No. 6 Phenol (17 mM)

No. 7 Lindane (6666 μM)

No. 8 Pentachlorophenol (74 μM)

No. 9 Trp-P-2(Acetate) (37 μM)

No. 10 4-Nitroquinoline-N-oxide (567 μM)

No. 11 Benzo(a)pyrene (111 μM)

No. 12 Paraquat (333 μM)

No. 13 Maneb (37 μM)

No. 14 Cadmium chloride (333 μM)

No. 15 Bis phenol-A (123 μM)

No. 16 Di-2-ethylhexyl phthalate (92.6 μM)

No. 17 2,5-Dichlorophenol (13.7 μM)

No. 18 2,4-Dichlorophenoxy acetic acid (247 μM)

- No. 19 Formaldehyde (555  $\mu$ M)  
 No. 20 p-Nonylphenol (666  $\mu$ M)  
 No. 21 Sodium Arsenite (111  $\mu$ M)  
 No. 22 Thiuram (12.3  $\mu$ M)  
 No. 23 2,4,5-Trichlorophenol (13.7  $\mu$ M)  
 No. 24 potassium dichromate (33  $\mu$ M)  
 No. 25 Triphenyltin chloride (3.3  $\mu$ M)

【0008】指標化学物質に関しては、前記においては25種を示したが、化学物質のより正確な微生物学的同定を行うには、できるだけ多数の化学物質を選定するのが好ましいことは明らかである。従って、指標化学物質は上記のものに限定されるものでないことは当然である。

【0009】指標微生物としては、その種類が異なったものを多数選ぶのが好ましいが、その指標微生物の具体例を示すと以下の通りである。

(1) *Acetobacter pasteurianus* IFO 3188

この微生物は、塩化メチル水銀 (methylmercury chloride) に対して感受性を示す微生物である。この微生物は、1  $\mu$ M程度の塩化メチル水銀の存在下ではほぼ完全にその生育が阻止され、0.3  $\mu$ M程度の濃度でも明らかな増殖阻害を生じる。他の化学物質に対する感受性は表1に示す。

(2) *Acetobacter pasteurianus* IFO 3129

この微生物は、塩化ニッケルに感受性を示す微生物である。この微生物は0.17  $\mu$ M程度の塩化ニッケルの存在下では60%程度の生育を示すにとどまった。他の化学物質に対する感受性は表2に示す。

(3) *Glycomyces rutgersensis* IFO 14488

この微生物は、2-アミノアントラセンに感受性を示す微生物である。この微生物は、2-アミノアントラセン4.6  $\mu$ M程度の濃度においても感受性を示す。他の化学物質に対する感受性は表3に示す。

(4) *Aureobacterium esteraromatium* IFO 3752

この微生物は、塩化トリブチルスズに感受性を示す微生物である。この微生物は、塩化トリブチルスズに対しては0.003  $\mu$ M程度の低濃度まで感受性を示す。他の化学物質に対する感受性は表4に示す。

(5) *Comamonas Testosteroni* IAM 1048

この微生物は、マラチオン (Malathion) に感受性を示す微生物である。この微生物は、0.3  $\mu$ M程度のマラチオンの存在下で明らかな生育阻害を生じた。他の化学物質に対する感受性は表5に示す。

(6) *Pseudomonas synxantha* IFO 3913

この微生物は、フェノールに感受性を示す微生物である。この微生物は、フェノール濃度23  $\mu$ M程度で明らかな増殖阻害を示した。他の化学物質に対する感受性は表6に示す。

(7) *Staphylococcus aureus* IFO 3060

この微生物は、リンダン (Lindane) に感受性を示す微

生物である。この微生物は、リンダン0.34  $\mu$ M程度においても生育阻害を示した。他の化学物質に対する感受性は表7に示す。以上に示した7種類の微生物は、化学物質に対する感受性は異なり、それぞれ異なった化学物質に対して強い感受性を示す。

【0010】指標微生物の生育 (培養) は、L培地 (酵母エキス1%、ポリペプトン0.5%) を用いて行った。生育は、96穴マイクロプレート上で25℃で行ない、650 nmの吸光度でその生育 (微生物濃度) を観察した。この場合、培地には、所定化学物質を所定濃度で添加した。後記表1～表7に、前記指標化学物質に対する前記指標微生物の感受性 (微生物/化学物質濃度データ) を示す。なお、以下に示す表1～7において、生育の欄に示した650 nmの吸光度の数値は、その上欄に示した化学物質の濃度 ( $\mu$ M) の数値に対応するものである。例えば、表1の(1) *Acetobacter pasteurianus* IFO3188における生育の欄の吸光度1.02及び0.116は、その上欄のMethylmercury chlorideの濃度 ( $\mu$ M) 0.000及び0.034に対応するものである。

【0011】

【表1】(1) *Acetobacter pasteurianus* IFO3188の化学物質感受性

Methylmercury chloride 濃度 ( $\mu$ M)	0.000	0.034	0.10	2	0.305	0.914	2.7418	222	24.667	74.000	222.000	66	6.000
生育 (Absorbance at 650nm)	0.102	0.116	0.108	0.085	0.024	0.021	0.0240	0.025	0.024	0.024	0.018		
Nickel chloride 濃度 ( $\mu$ M)	0.000	0.169	0.508	1.524	4.572	13.716	41.148123	444	370.333	1111.000	3333.	000	
生育 (Absorbance at 650nm)	0.109	0.113	0.112	0.119	0.114	0.114	0.1140	0.117	0.100	0.012	0.013		
2-Aminoanthracene 濃度 ( $\mu$ M)	0.000	0.169	0.508	1.5	24	4.572	13.716	41.148123	444	370.333	1111.000	333	3.000
生育 (Absorbance at 650nm)	0.101	0.109	0.116	0.110	0.107	0.106	0.0900	0.089	0.065	-0.048	-0.091		
Tributyltin chloride 濃度 ( $\mu$ M)	0.000	0.003	0.010	0.030	0.091	0.2720	0.815	2.444	7.333	22.000	66.000		
生育 (Absorbance at 650nm)	0.104	0.049	0.048	0.049	0.046	0.040	0.0180	0.016	0.011	0.015	0.024	Malathion 濃度 ( $\mu$ M)	0.000
0.034	0.102	0.305	0.914	2.741	8.	222	24.667	74.000	222.000	666.000			
生育 (Absorbance at 650nm)	0.111	0.111	0.127	0.120	0.126	0.120	0.1230	0.120	0.108	0.081	-0.003		
Phenol 濃度 ( $\mu$ M)	0.000	0.847	2.540	7.620	22.861	6	8.584	205.753	617.2591851	778	5555.333	16666.000	
生育 (Absorbance at 650nm)	0.107	0.112	0.124	0.108	0.107	0.099	0.0800	0.075	0.038	0.027	0.018		
Lindane 濃度 ( $\mu$ M)	0.000	0.339	1.016	3.048	9.144	2							

7.432 82.296 246.889740.667 2222.000 6666.000生育	0.119 0.121 0.1150.107 0.081 0.018 0.021Formaldehy
(Absorbance at 650nm) 0.108 0.111 0.119 0.121 0.1	de 濃度 ( $\mu\text{M}$ ) 0.000 0.085 0.254 0.762 2.285 6.856
18 0.085 0.0700.094 0.100 0.094 -0.063	20.56861.704 185.111 555.333 1666.000
Pentachlorophenol 濃度 ( $\mu\text{M}$ ) 0.000 0.034 0.102 0.3	生育 (Absorbance at 650nm) 0.109 0.098 0.116 0.116
05 0.914 2.741 8.22224.667 74.000 222.000 666.000	0.115 0.114 0.1120.086 0.048 0.019 0.015
生育 (Absorbance at 650nm) 0.104 0.113 0.123 0.111	p-Nonylphenol 濃度 ( $\mu\text{M}$ ) 0.000 0.034 0.102 0.305
0.086 0.037 0.0180.018 0.018 0.017 0.014	0.914 2.741 8.22224.667 74.000 222.000 666.000
Trp-P-2(Acetate) 濃度 ( $\mu\text{M}$ ) 0.000 0.017 0.051 0.15	生育 (Absorbance at 650nm) 0.108 0.086 0.126 0.126
2 0.457 1.370 4.11112.333 37.000 111.000 333.000	0.112 0.020 0.0140.011 0.012-0.024 0.099
生育 (Absorbance at 650nm) 0.098 0.120 0.121 0.110	Sodium Arsenite 濃度 ( $\mu\text{M}$ ) 0.000 0.017 0.051 0.152
0.111 0.102 0.0740.061 0.039 0.015 0.074	0.457 1.370 4.11112.333 37.000 111.000 333.000
4-Nitroquinoline-N-oxide 濃度 ( $\mu\text{M}$ ) 0.000 0.001 0.	生育 (Absorbance at 650nm) 0.111 0.113 0.121 0.122
003 0.008 0.023 0.0700.210 0.630 1.889 5.667 17.00	0.125 0.121 0.1230.112 0.047 0.026 0.009Thiuram
0	濃度 ( $\mu\text{M}$ ) 0.000 0.017 0.051 0.152 0.457 1.370 4.1
生育 (Absorbance at 650nm) 0.121 0.114 0.121 0.112	11 12.33337.000 111.000 333.000
0.120 0.109 0.1040.098 0.082 0.018 0.014	生育 (Absorbance at 650nm) 0.112 0.107 0.113 0.106
Benzo(a)pyrene 濃度 ( $\mu\text{M}$ ) 0.000 0.017 0.051 0.152	0.105 0.080 0.0500.027 0.018 0.013 0.013
0.457 1.370 4.11112.333 37.000 111.000 333.000	2,4,5-Trichlorophenol 濃度 ( $\mu\text{M}$ ) 0.000 0.169 0.508
生育 (Absorbance at 650nm) 0.093 0.090 0.121 0.120	1.524 4.572 13.71641.148 123.444 370.333 1111.000
0.120 0.115 0.1110.095 0.081 0.060 0.051	3333.000
Paraquat 濃度 ( $\mu\text{M}$ ) 0.000 0.051 0.152 0.457 1.372	生育 (Absorbance at 650nm) 0.118 0.113 0.122 0.109
4.115 12.346 37.037111.111 333.333 1000.000	0.065 0.019 0.0180.018 0.016 0.020 0.027
生育 (Absorbance at 650nm) 0.110 0.107 0.114 0.107	Potassium dichromate 濃度 ( $\mu\text{M}$ ) 0.000 0.002 0.005
0.103 0.093 0.0750.059 0.024 0.017 0.015	0.015 0.045 0.1360.407 1.222 3.667 11.000 33.000
Maneb 濃度 ( $\mu\text{M}$ ) 0.000 0.017 0.051 0.152 0.457 1.3	生育 (Absorbance at 650nm) 0.115 0.107 0.114 0.113
70 4.111 12.333 37.000111.000 333.000	0.111 0.110 0.1160.115 0.112 0.104 0.079
生育 (Absorbance at 650nm) 0.111 0.116 0.127 0.123	Triphenyltin chloride 濃度 ( $\mu\text{M}$ ) 0.000 0.000 0.001
0.125 0.120 0.1140.085 0.014 0.009 0.018	0.002 0.005 0.0140.041 0.122 0.367 1.100 3.300
Cadmium chloride 濃度 ( $\mu\text{M}$ ) 0.000 0.017 0.051 0.15	生育 (Absorbance at 650nm) 0.107 0.112 0.110 0.106
2 0.457 1.370 4.11112.333 37.000 111.000 333.000	0.105 0.106 0.1000.108 0.104 0.091 0.083
生育 (Absorbance at 650nm) 0.106 0.098 0.115 0.115	【0012】
0.111 0.102 0.0900.055 0.020 0.017 0.016	【表2】(2) Acetobacter pasteurianus IF03129の化
Bis-phenol-A 濃度 ( $\mu\text{M}$ ) 0.000 0.169 0.508 1.524 4.	学物質感受性
572 13.716 41.148123.444 370.333 1111.000 3333.000	Methylmercury chloride 濃度 ( $\mu\text{M}$ ) 0.000 0.034 0.10
生育 (Absorbance at 650nm) 0.090 0.095 0.121 0.125	2 0.305 0.914 2.7418.222 24.667 74.000 222.000 66
0.119 0.112 0.0950.063 0.021 0.020 0.070	6.000
Di-2-ethylhexyl phthalate 濃度 ( $\mu\text{M}$ ) 0.000 0.042	生育 (Absorbance at 650nm) 0.260 0.313 0.292 0.269
0.127 0.381 1.143 3.42810.284 30.852 92.556 277.66	0.165 0.036 0.0470.047 0.041 0.034 0.032
7 833.000	Nickel chloride 濃度 ( $\mu\text{M}$ ) 0.000 0.169 0.508 1.524
生育 (Absorbance at 650nm) 0.091 0.087 0.118 0.114	4.572 13.716 41.148123.444 370.333 1111.000 3333.
0.118 0.116 0.1100.094 0.066 0.047 0.0522,5-Dichl	000
orophenol 濃度 ( $\mu\text{M}$ ) 0.000 0.169 0.508 1.524 4.572	生育 (Absorbance at 650nm) 0.556 0.345 0.265 0.264
13.716	0.261 0.265 0.5840.272 0.480 0.114 0.026
41.148 123.444 370.333 1111.000 3333.000	2-Aminoanthracene 濃度 ( $\mu\text{M}$ ) 0.000 0.169 0.508 1.5
生育 (Absorbance at 650nm) 0.098 0.090 0.121 0.122	24 4.572 13.716 41.148123.444 370.333 1111.000 333
0.126 0.127 0.1060.070 0.021 0.017 0.017	3.000生育 (Absorbance at 650nm) 0.272 0.296 0.284
2,4-Dichlorophenoxy acetic acid 濃度 ( $\mu\text{M}$ ) 0.000	0.269 0.267 0.264 0.2370.198 0.166 0.031 -0.040
0.339 1.016 3.048 9.14427.432 82.296 246.889 740.6	Tributyltin chloride 濃度 ( $\mu\text{M}$ ) 0.000 0.003 0.010
67 2222.000 6666.000	0.030 0.091 0.2720.815 2.444 7.333 22.000 66.000
生育 (Absorbance at 650nm) 0.099 0.098 0.118 0.126	生育 (Absorbance at 650nm) 0.278 0.047 0.047 0.047

0.046 0.046 0.0390.025 0.013 0.016 0.030  
 Malathion 濃度 ( $\mu\text{M}$ ) 0.000 0.034 0.102 0.305 0.914  
 2.741 8.222 24.66774.000 222.000 666.000  
 生育 (Absorbance at 650nm) 0.265 0.252 0.255 0.253  
 0.243 0.230 0.2310.223 0.214 0.168 0.083  
 Phenol 濃度 ( $\mu\text{M}$ ) 0.000 0.847 2.540 7.620 22.861 6  
 8.584 205.753 617.2591851.778 5555.333 16666.000  
 生育 (Absorbance at 650nm) 0.323 0.300 0.323 0.305  
 0.289 0.283 0.2670.224 0.178 0.071 0.032  
 Lindane 濃度 ( $\mu\text{M}$ ) 0.000 0.339 1.016 3.048 9.144 2  
 7.432 82.296 246.889740.667 2222.000 6666.000  
 生育 (Absorbance at 650nm) 0.234 0.234 0.235 0.235  
 0.221 0.168 0.1370.164 0.158 0.132 -0.114  
 Pentachlorophenol 濃度 ( $\mu\text{M}$ ) 0.000 0.034 0.102 0.3  
 05 0.914 2.741 8.22224.667 74.000 222.000 666.000  
 生育 (Absorbance at 650nm) 0.271 0.228 0.213 0.199  
 0.155 0.073 0.0290.021 0.023 0.021 0.021  
 Trp-P-2(Acetate) 濃度 ( $\mu\text{M}$ ) 0.000 0.017 0.051 0.15  
 2 0.457 1.370 4.11112.333 37.000 111.000 333.000  
 生育 (Absorbance at 650nm) 0.648 0.580 0.288 0.285  
 0.274 0.140 0.0700.036 0.023 0.023 0.068  
 4-Nitroquinoline-N-oxide 濃度 ( $\mu\text{M}$ ) 0.000 0.001 0.  
 003 0.008 0.023 0.0700.210 0.630 1.889 5.667 17.00  
 0  
 生育 (Absorbance at 650nm) 0.296 0.299 0.298 0.303  
 0.303 0.289 0.2810.240 0.154 0.021 0.024  
 Benzo(a)pyrene 濃度 ( $\mu\text{M}$ ) 0.000 0.017 0.051 0.152  
 0.457 1.370 4.11112.333 37.000 111.000 333.000  
 生育 (Absorbance at 650nm) 0.077 0.079 0.078 0.079  
 0.076 0.074 0.0710.054 0.047 0.047 0.048  
 Paraquat 濃度 ( $\mu\text{M}$ ) 0.000 0.051 0.152 0.457 1.372  
 4.115 12.346 37.037111.111 333.333 1000.000  
 生育 (Absorbance at 650nm) 0.349 0.311 0.314 0.276  
 0.236 0.193 0.1560.123 0.049 0.032 0.024  
 Maneb 濃度 ( $\mu\text{M}$ ) 0.000 0.017 0.051 0.152 0.457 1.3  
 70 4.111 12.333 37.000111.000 333.000  
 生育 (Absorbance at 650nm) 0.341 0.323 0.371 0.332  
 0.671 0.601 0.5970.250 0.642 0.059 0.027  
 Cadmium chloride 濃度 ( $\mu\text{M}$ ) 0.000 0.017 0.051 0.15  
 2 0.457 1.370 4.11112.333 37.000 111.000 333.000  
 生育 (Absorbance at 650nm) 0.252 0.247 0.245 0.227  
 0.210 0.192 0.1600.120 0.021 0.017 0.024  
 Bis-phenol-A 濃度 ( $\mu\text{M}$ ) 0.000 0.169 0.508 1.524 4.  
 572 13.716 41.148123.444 370.333 1111.000 3333.000  
 生育 (Absorbance at 650nm) 0.246 0.257 0.242 0.250  
 0.242 0.225 0.2010.090 0.030 0.024 0.178  
 Di-2-ethylhexyl phthalate 濃度 ( $\mu\text{M}$ ) 0.000 0.042  
 0.127 0.381 1.143 3.42810.284 30.852 92.556 277.66  
 7 833.000  
 生育 (Absorbance at 650nm) 0.245 0.235 0.235 0.234

0.238 0.223 0.2130.188 0.159 0.119 0.055  
 2,5-Dichlorophenol 濃度 ( $\mu\text{M}$ ) 0.000 0.169 0.508 1.  
 524 4.572 13.716  
 41.148 123.444 370.333 1111.000 3333.000生育 (Abso  
 rbance at 650nm) 0.252 0.264 0.260 0.262 0.235 0.2  
 38 0.2300.193 0.036 0.029 0.024  
 2,4-Dichlorophenoxy acetic acid 濃度 ( $\mu\text{M}$ ) 0.000  
 0.339 1.016 3.048 9.14427.432 82.296 246.889 740.6  
 67 2222.000 6666.000  
 生育 (Absorbance at 650nm) 0.248 0.262 0.257 0.265  
 0.254 0.246 0.2180.191 0.135 0.032 0.045  
 Formaldehyde 濃度 ( $\mu\text{M}$ ) 0.000 0.085 0.254 0.762 2.  
 285 6.856 20.568  
 61.704 185.111 555.333 1666.000  
 生育 (Absorbance at 650nm) 0.252 0.266 0.248 0.247  
 0.262 0.233 0.2270.174 0.035 0.034 0.033  
 p-Nonylphenol 濃度 ( $\mu\text{M}$ ) 0.000 0.034 0.102 0.305  
 0.914 2.741 8.22224.667 74.000 222.000 666.000  
 生育 (Absorbance at 650nm) 0.280 0.271 0.275 0.269  
 0.249 0.185 0.0120.010 0.010 0.014 0.042  
 Sodium Arsenite 濃度 ( $\mu\text{M}$ ) 0.000 0.017 0.051 0.152  
 0.457 1.370 4.11112.333 37.000 111.000 333.000  
 生育 (Absorbance at 650nm) 0.281 0.265 0.234 0.165  
 0.279 0.282 0.2650.259 0.166 0.036 0.013  
 Thiuram 濃度 ( $\mu\text{M}$ ) 0.000 0.017 0.051 0.152 0.457  
 1.370 4.111 12.33337.000 111.000 333.000  
 生育 (Absorbance at 650nm) 0.286 0.294 0.331 0.383  
 0.279 0.361 0.2700.150 0.041 0.035 0.025  
 2,4,5-Trichlorophenol 濃度 ( $\mu\text{M}$ ) 0.000 0.169 0.508  
 1.524 4.572 13.71641.148 123.444 370.333 1111.000  
 3333.000  
 生育 (Absorbance at 650nm) 0.285 0.270 0.265 0.201  
 0.110 0.027 0.0260.023 0.022 0.035 0.046Potassium  
 dichlomite 濃度 ( $\mu\text{M}$ ) 0.000 0.002 0.005 0.015 0.0  
 45 0.1360.407 1.222 3.667 11.000 33.000生育 (Absor  
 bance at 650nm) 0.281 0.267 0.546 0.276 0.275 0.73  
 6 0.2710.264 0.259 0.473 0.218  
 Triphenyltin chloride 濃度 ( $\mu\text{M}$ ) 0.000 0.000 0.001  
 0.002 0.005 0.0140.041 0.122 0.367 1.100 3.300  
 生育 (Absorbance at 650nm) 0.323 0.454 0.311 0.303  
 0.476 0.288 0.2870.290 0.275 0.273 0.240  
 【0013】  
 【表3】(3) Glysomyces rutagersensis IF014488の  
 化学物質感受性  
 Methylmercury chloride 濃度 ( $\mu\text{M}$ ) 0.000 0.034 0.10  
 2 0.305 0.914 2.7418.222 24.667 74.000 222.000 66  
 6.000  
 生育 (Absorbance at 650nm) 0.066 0.065 0.069 0.068  
 0.047 0.042 0.0380.032 0.026 0.021 0.018  
 Nickel chloride 濃度 ( $\mu\text{M}$ ) 0.000 0.169 0.508 1.524

4.572 13.716 41.148123.444 370.333 1111.000 3333.000	Cadmium chloride 濃度 ( $\mu\text{M}$ ) 0.000 0.017 0.051 0.15
生育 (Absorbance at 650nm) 0.041 0.038 0.039 0.042	2 0.457 1.370 4.11112.333 37.000 111.000 333.000
0.042 0.044 0.0420.040 0.025 0.025 0.024	生育 (Absorbance at 650nm) 0.045 0.043 0.042 0.037
2-Aminoanthracene 濃度 ( $\mu\text{M}$ ) 0.000 0.169 0.508 1.5	0.033 0.033 0.0330.031 0.029 0.029 0.027
24 4.572 13.716 41.148123.444 370.333 1111.000 333	Bis-phenol-A 濃度 ( $\mu\text{M}$ ) 0.000 0.169 0.508 1.524 4.
3.000	572 13.716 41.148123.444 370.333 1111.000 3333.000
生育 (Absorbance at 650nm) 0.076 0.070 0.076 0.069	生育 (Absorbance at 650nm) 0.060 0.058 0.062 0.064
0.061 0.058 0.0470.029 0.003 -0.015 -0.157	0.059 0.055 0.0520.042 0.030 0.026 0.058Di-2-ethy
Tributyltin chloride 濃度 ( $\mu\text{M}$ ) 0.000 0.003 0.010	lhexyl phthalate 濃度 ( $\mu\text{M}$ ) 0.000 0.042 0.127 0.38
0.030 0.091 0.2720.815 2.444 7.333 22.000 66.000生育	1 1.143 3.42810.284 30.852 92.556 277.667 833.000
生育 (Absorbance at 650nm) 0.058 0.053 0.052 0.051	生育 (Absorbance at 650nm) 0.052 0.052 0.053 0.051
0.050 0.043 0.0370.029 0.025 0.026 0.036	0.053 0.051 0.0500.039 0.036 0.022 0.020
Malathion 濃度 ( $\mu\text{M}$ ) 0.000 0.034 0.102 0.305 0.914	2,5-Dichlorophenol 濃度 ( $\mu\text{M}$ ) 0.000 0.169 0.508 1.
2.741 8.222 24.66774.000 222.000 666.000	524 4.572 13.716
生育 (Absorbance at 650nm) 0.059 0.052 0.053 0.052	41.148 123.444 370.333 1111.000 3333.000
0.054 0.053 0.0540.051 0.048 0.045 0.006	生育 (Absorbance at 650nm) 0.062 0.059 0.061 0.060
Phenol 濃度 ( $\mu\text{M}$ ) 0.000 0.847 2.540 7.620 22.861 6	0.059 0.056 0.0540.044 0.030 0.024 0.0202,4-Dichl
8.584 205.753 617.2591851.778 5555.333 16666.000	orophenoxy acetic acid 濃度 ( $\mu\text{M}$ ) 0.000 0.339 1.01
生育 (Absorbance at 650nm) 0.044 0.059 0.059 0.061	6 3.048 9.14427.432 82.296 246.889 740.667 2222.00
0.059 0.054 0.0500.047 0.038 0.032 0.025	0 6666.000
Lindane 濃度 ( $\mu\text{M}$ ) 0.000 0.339 1.016 3.048 9.144 2	生育 (Absorbance at 650nm) 0.062 0.058 0.063 0.061
7.432 82.296 246.889740.667 2222.000 6666.000	0.057 0.055 0.0520.050 0.033 0.022 0.026
生育 (Absorbance at 650nm) 0.049 0.046 0.046 0.050	Formaldehyde 濃度 ( $\mu\text{M}$ ) 0.000 0.085 0.254 0.762 2.
0.049 0.048 0.0490.066 0.073 0.090 -0.082	285 6.856 20.56861.704 185.111 555.333 1666.000
Pentachlorophenol 濃度 ( $\mu\text{M}$ ) 0.000 0.034 0.102 0.3	生育 (Absorbance at 650nm) 0.054 0.050 0.054 0.054
05 0.914 2.741 8.22224.667 74.000 222.000 666.000	0.053 0.052 0.0510.050 0.048 0.036 0.021
生育 (Absorbance at 650nm) 0.052 0.049 0.049 0.046	p-Nonylphenol 濃度 ( $\mu\text{M}$ ) 0.000 0.034 0.102 0.305
0.044 0.038 0.0290.027 0.028 0.028 0.030	0.914 2.741 8.22224.667 74.000 222.000 666.000
Trp-P-2(Acetate) 濃度 ( $\mu\text{M}$ ) 0.000 0.017 0.051 0.15	生育 (Absorbance at 650nm) 0.056 0.054 0.052 0.052
2 0.457 1.370 4.11112.333 37.000 111.000 333.000	0.048 0.045 0.0310.021 0.019 0.023 0.069
生育 (Absorbance at 650nm) 0.053 0.053 0.053 0.050	Sodium Arsenite 濃度 ( $\mu\text{M}$ ) 0.000 0.017 0.051 0.152
0.049 0.047 0.0420.027 0.027 0.029 0.133	0.457 1.370 4.111
4-Nitroquinoline-N-oxide 濃度 ( $\mu\text{M}$ ) 0.000 0.001 0.	12.333 37.000 111.000 333.000
003 0.008 0.023 0.0700.210 0.630 1.889 5.667 17.00	生育 (Absorbance at 650nm) 0.049 0.047 0.049 0.047
0	0.047 0.045 0.0440.040 0.040 0.041 0.035
生育 (Absorbance at 650nm) 0.066 0.061 0.059 0.056	Thiuram 濃度 ( $\mu\text{M}$ ) 0.000 0.017 0.051 0.152 0.457
0.055 0.054 0.0480.047 0.043 0.036 0.030	1.370 4.111 12.33337.000 111.000 333.000
Benzo(a)pyrene 濃度 ( $\mu\text{M}$ ) 0.000 0.017 0.051 0.152	生育 (Absorbance at 650nm) 0.053 0.048 0.049 0.047
0.457 1.370 4.11112.333 37.000 111.000 333.000	0.044 0.042 0.0340.028 0.023 0.022 0.025
生育 (Absorbance at 650nm) 0.055 0.053 0.058 0.058	2,4,5-Trichlorophenol 濃度 ( $\mu\text{M}$ ) 0.000 0.169 0.508
0.054 0.049 0.0450.042 0.035 0.026 0.019	1.524 4.572 13.71641.148 123.444 370.333 1111.000
Paraquat 濃度 ( $\mu\text{M}$ ) 0.000 0.051 0.152 0.457 1.372	3333.000
4.115 12.346 37.037111.111 333.333 1000.000	生育 (Absorbance at 650nm) 0.056 0.053 0.053 0.050
生育 (Absorbance at 650nm) 0.053 0.051 0.054 0.055	0.039 0.033 0.0310.029 0.031 0.030 0.046
0.054 0.054 0.0510.049 0.052 0.046 0.041	Potassium dichlomite 濃度 ( $\mu\text{M}$ ) 0.000 0.002 0.005
Maneb 濃度 ( $\mu\text{M}$ ) 0.000 0.017 0.051 0.152 0.457 1.3	0.015 0.045 0.136
70 4.111 12.333 37.000111.000 333.000生育 (Absorba	0.407 1.222 3.667 11.000 33.000
nance at 650nm) 0.057 0.050 0.050 0.051 0.050 0.047	生育 (Absorbance at 650nm) 0.041 0.036 0.041 0.043
0.0440.042 0.032 0.025 0.030	0.043 0.043 0.0440.042 0.040 0.037 0.037
	Triphenyltin chloride 濃度 ( $\mu\text{M}$ ) 0.000 0.000 0.001



0.002 0.005 0.014	0.118 0.118 0.1010.096 0.081 0.068 0.066
0.041 0.122 0.367 1.100 3.300	Benzo(a)pyrene 濃度 ( $\mu\text{M}$ ) 0.000 0.017 0.051 0.152
生育 (Absorbance at 650nm) 0.044 0.045 0.049 0.049	0.457 1.370 4.111
0.049 0.052 0.0500.044 0.034 0.026 0.020	12.333 37.000 111.000 333.000
【0014】	生育 (Absorbance at 650nm) 0.096 0.097 0.118 0.117
【表4】(4) Aureobacterium esteraromatium IFD 37	0.113 0.110 0.1070.099 0.087 0.077 0.126
52の化学物質感受性	Paraquat 濃度 ( $\mu\text{M}$ ) 0.000 0.051 0.152 0.457 1.372
Methylmercury chloride 濃度 ( $\mu\text{M}$ ) 0.000 0.034 0.10	4.115 12.346 37.037111.111 333.333 1000.000
2 0.305 0.914 2.7418.222 24.667 74.000 222.000 66	生育 (Absorbance at 650nm) 0.097 0.089 0.120 0.117
6.000	0.112 0.104 0.0890.085 0.065 0.049 0.032
生育 (Absorbance at 650nm) 0.091 0.107 0.110 0.093	Maneb 濃度 ( $\mu\text{M}$ ) 0.000 0.017 0.051 0.152 0.457 1.3
0.043 0.023 0.0220.023 0.022 0.021 0.018	70 4.111 12.333 37.000111.000 333.000
Nickel chloride 濃度 ( $\mu\text{M}$ ) 0.000 0.169 0.508 1.524	生育 (Absorbance at 650nm) 0.107 0.102 0.121 0.120
4.572 13.716 41.148123.444 370.333 1111.000 3333.	0.122 0.119 0.1160.105 0.074 0.024 0.036
000	Cadmium chloride 濃度 ( $\mu\text{M}$ ) 0.000 0.017 0.051 0.15
生育 (Absorbance at 650nm) 0.098 0.106 0.116 0.112	2 0.457 1.370 4.11112.333 37.000 111.000 333.000
0.116 0.111 0.1120.114 0.110 0.084 0.016	生育 (Absorbance at 650nm) 0.090 0.094 0.119 0.119
2-Aminoanthracene 濃度 ( $\mu\text{M}$ ) 0.000 0.169 0.508 1.5	0.112 0.105 0.0930.085 0.046 0.020 0.020
24 4.572 13.716 41.148123.444 370.333 1111.000 333	Bis-phenol-A 濃度 ( $\mu\text{M}$ ) 0.000 0.169 0.508 1.524 4.
3.000	572 13.716 41.148123.444 370.333 1111.000 3333.000
生育 (Absorbance at 650nm) 0.095 0.093 0.113 0.104	生育 (Absorbance at 650nm) 0.088 0.092 0.123 0.123
0.099 0.099 0.0900.091 0.069 0.008 -0.108	0.121 0.111 0.0950.080 0.019 0.018 0.052
Tributyltin chloride 濃度 ( $\mu\text{M}$ ) 0.000 0.003 0.010	Di-2-ethylhexyl phthalate 濃度 ( $\mu\text{M}$ ) 0.000 0.042
0.030 0.091 0.2720.815 2.444 7.333 22.000 66.000	0.127 0.381 1.143 3.42810.284 30.852 92.556 277.66
生育 (Absorbance at 650nm) 0.105 0.037 0.044 0.044	7 833.000生育 (Absorbance at 650nm) 0.087 0.069 0.
0.042 0.038 0.0300.018 0.014 0.023 0.032Malathion	122 0.119 0.121 0.117 0.1090.096 0.075 0.052 0.048
濃度 ( $\mu\text{M}$ ) 0.000 0.034 0.102 0.305 0.914 2.741 8.	2,5-Dichlorophenol 濃度 ( $\mu\text{M}$ ) 0.000 0.169 0.508 1.
222 24.66774.000 222.000 666.000	524 4.572 13.71641.148 123.444 370.333 1111.000 33
生育 (Absorbance at 650nm) 0.101 0.098 0.122 0.120	33.000
0.119 0.113 0.1050.100 0.088 0.068 -0.001	生育 (Absorbance at 650nm) 0.097 0.103 0.129 0.127
Phenol 濃度 ( $\mu\text{M}$ ) 0.000 0.847 2.540 7.620 22.861 6	0.128 0.122 0.1130.086 0.020 0.017 0.019
8.584 205.753 617.2591851.778 5555.333 16666.000	2,4-Dichlorophenoxy acetic acid 濃度 ( $\mu\text{M}$ ) 0.000
生育 (Absorbance at 650nm) 0.100 0.099 0.121 0.114	0.339 1.016 3.048 9.14427.432 82.296 246.889 740.6
0.107 0.105 0.1010.098 0.085 0.045 0.023	67 2222.000 6666.000
Lindane 濃度 ( $\mu\text{M}$ ) 0.000 0.339 1.016 3.048 9.144 2	生育 (Absorbance at 650nm) 0.093 0.103 0.124 0.122
7.432 82.296 246.889740.667 222.000 6666.000	0.124 0.124 0.1160.100 0.075 0.018 0.027
生育 (Absorbance at 650nm) 0.103 0.110 0.131 0.132	Formaldehyde 濃度 ( $\mu\text{M}$ ) 0.000 0.085 0.254 0.762 2.
0.126 0.099 0.0770.093 0.103 0.111 -0.059	285 6.856 20.56861.704 185.111 555.333 1666.000
Pentachlorophenol 濃度 ( $\mu\text{M}$ ) 0.000 0.034 0.102 0.3	生育 (Absorbance at 650nm) 0.097 0.107 0.122 0.123
05 0.914 2.741 8.22224.667 74.000 222.000 666.000	0.119 0.121 0.1200.112 0.084 0.044 0.015
生育 (Absorbance at 650nm) 0.095 0.098 0.116 0.115	p-Nonylphenol 濃度 ( $\mu\text{M}$ ) 0.000 0.034 0.102 0.305
0.093 0.054 0.0220.021 0.019 0.017 0.021	0.914 2.741 8.22224.667 74.000 222.000 666.000
Trp-P-2(Acetate) 濃度 ( $\mu\text{M}$ ) 0.000 0.017 0.051 0.15	生育 (Absorbance at 650nm) 0.102 0.090 0.076 0.111
2 0.457 1.370 4.11112.333 37.000 111.000 333.000生育	0.108 0.095 0.0150.016 0.013 0.022 0.101
(Absorbance at 650nm) 0.089 0.098 0.107 0.107	Sodium Arsenite 濃度 ( $\mu\text{M}$ ) 0.000 0.017 0.051 0.152
0.103 0.089 0.0560.039 0.030 0.023 0.056	0.457 1.370 4.11112.333 37.000 111.000 333.000
4-Nitroquinoline-N-oxide 濃度 ( $\mu\text{M}$ ) 0.000 0.001 0.	生育 (Absorbance at 650nm) 0.098 0.094 0.122 0.120
003 0.008 0.023 0.0700.210 0.630 1.889 5.667 17.00	0.119 0.119 0.1110.107 0.100 0.088 0.065
0	Thiuram 濃度 ( $\mu\text{M}$ ) 0.000 0.017 0.051 0.152 0.457
生育 (Absorbance at 650nm) 0.106 0.111 0.121 0.118	1.370 4.111 12.33337.000 111.000 333.000

生育 (Absorbance at 650nm) 0.105 0.097 0.124 0.122  
0.123 0.109 0.0820.040 0.020 0.017 0.016

2,4,5-Trichlorophenol 濃度 ( $\mu\text{M}$ ) 0.000 0.169 0.508  
1.524 4.572 13.71641.148 123.444 370.333 1111.000  
3333.000

生育 (Absorbance at 650nm) 0.098 0.095 0.115 0.110  
0.081 0.021 0.0200.020 0.020 0.023 0.033

Potassium dichromate 濃度 ( $\mu\text{M}$ ) 0.000 0.002 0.005  
0.015 0.045 0.1360.407 1.222 3.667 11.000 33.000

生育 (Absorbance at 650nm) 0.105 0.101 0.121 0.122  
0.124 0.117 0.1180.120 0.116 0.109 0.088

Triphenyltin chloride 濃度 ( $\mu\text{M}$ ) 0.000 0.000 0.001  
0.002 0.005 0.0140.041 0.122 0.367 1.100 3.300

生育 (Absorbance at 650nm) 0.100 0.096 0.107 0.110  
0.109 0.103 0.1000.085 0.056 0.029 0.019

【0015】

【表5】(5) Comamonas Testosteroni IAM1048の化学  
物質感受性

Methylmercury chloride 濃度 ( $\mu\text{M}$ ) 0.000 0.034 0.10  
2 0.305 0.914 2.7418.222 24.667 74.000 222.000 66  
6.000

生育 (Absorbance at 650nm) 0.420 0.419 0.417 0.381  
0.080 0.059 0.0560.056 0.057 0.048 0.039

Nickel chloride 濃度 ( $\mu\text{M}$ ) 0.000 0.169 0.508 1.524  
4.572 13.716 41.148123.444 370.333 1111.000 3333.  
000

生育 (Absorbance at 650nm) 0.316 0.302 0.314 0.313  
0.303 0.302 0.2930.285 0.279 0.178 -0.005

2-Aminoanthracene 濃度 ( $\mu\text{M}$ ) 0.000 0.169 0.508 1.5  
24 4.572 13.716 41.148123.444 370.333 1111.000 333  
3.000

生育 (Absorbance at 650nm) 0.417 0.412 0.435  
0.420 0.425 0.413 0.3900.335 0.248 0.118 -0.084

Tributyltin chloride 濃度 ( $\mu\text{M}$ ) 0.000 0.003 0.010  
0.030 0.091 0.2720.815 2.444 7.333 22.000 66.000

生育 (Absorbance at 650nm) 0.401 0.406 0.401 0.394  
0.373 0.268 0.1550.074 0.056 0.051 0.072

Malathion 濃度 ( $\mu\text{M}$ ) 0.000 0.034 0.102 0.305 0.914  
2.741 8.222 24.66774.000 222.000 666.000

生育 (Absorbance at 650nm) 0.341 0.341 0.346 0.319  
0.314 0.300 0.2880.270 0.234 0.141 -0.101

Phenol 濃度 ( $\mu\text{M}$ ) 0.000 0.847 2.540 7.620 22.861 6  
8.584 205.753 617.2591851.778 5555.333 16666.000

生育 (Absorbance at 650nm) 0.321 0.302 0.312 0.315  
0.319 0.321 0.3050.302 0.269 0.156 0.000

Lindane 濃度 ( $\mu\text{M}$ ) 0.000 0.339 1.016 3.048 9.144 2  
7.432 82.296 246.889740.667 2222.000 6666.000

生育 (Absorbance at 650nm) 0.323 0.312 0.316 0.313  
0.302 0.267 0.2400.258 0.405 0.750 1.157

Pentachlorophenol 濃度 ( $\mu\text{M}$ ) 0.000 0.034 0.102 0.3  
05 0.914 2.741 8.22224.667 74.000 222.000 666.000

生育 (Absorbance at 650nm) 0.393 0.404 0.401 0.400  
0.379 0.337 0.2820.158 0.039 0.035 0.037

Trp-P-2(Acetate) 濃度 ( $\mu\text{M}$ ) 0.000 0.017 0.051 0.15  
2 0.457 1.370 4.11112.333 37.000 111.000 333.000

生育 (Absorbance at 650nm) 0.391 0.562 0.456 0.411  
0.418 0.361 0.2670.089 0.046 0.035 0.089

4-Nitroquinoline-N-oxide 濃度 ( $\mu\text{M}$ ) 0.000 0.001 0.  
003 0.008 0.023 0.0700.210 0.630 1.889 5.667 17.00

0生育 (Absorbance at 650nm) 0.399 0.406 0.412 0.39  
8 0.402 0.386 0.3660.355 0.345 0.284 0.140

Benzo(a)pyrene 濃度 ( $\mu\text{M}$ ) 0.000 0.017 0.051 0.152  
0.457 1.370 4.11112.333 37.000 111.000 333.000

生育 (Absorbance at 650nm) 0.416 0.425 0.445 0.443  
0.432 0.430 0.4250.409 0.386 0.306 -0.108

Paraquat 濃度 ( $\mu\text{M}$ ) 0.000 0.051 0.152 0.457 1.372  
4.115 12.346 37.037111.111 333.333 1000.000

生育 (Absorbance at 650nm) 0.327 0.314 0.326 0.313  
0.304 0.294 0.2590.168 -0.085 -0.543 -1.517

Maneb 濃度 ( $\mu\text{M}$ ) 0.000 0.017 0.051 0.152 0.457 1.3  
70 4.111 12.333 37.000111.000 333.000

生育 (Absorbance at 650nm) 0.316 0.304 0.314 0.311  
0.304 0.303 0.2840.257 0.165 0.041 0.003

Cadmium chloride 濃度 ( $\mu\text{M}$ ) 0.000 0.017 0.051 0.15  
2 0.457 1.370 4.11112.333 37.000 111.000 333.000

生育 (Absorbance at 650nm) 0.307 0.294 0.302 0.294  
0.287 0.297 0.2860.262 0.201 0.068 -0.269

Bis-phenol-A 濃度 ( $\mu\text{M}$ ) 0.000 0.169 0.508 1.524 4.  
572 13.716 41.148123.444 370.333 1111.000 3333.000

生育 (Absorbance at 650nm) 0.413 0.420 0.425 0.428  
0.423 0.388 0.3530.223 0.054 0.049 0.157

Di-2-ethylhexyl phthalate 濃度 ( $\mu\text{M}$ ) 0.000 0.042  
0.127 0.381 1.143 3.42810.284 30.852 92.556 277.66  
7 833.000

生育 (Absorbance at 650nm) 0.432 0.414 0.440 0.437  
0.438 0.426 0.4360.417 0.110 0.021 -0.143

2,5-Dichlorophenol 濃度 ( $\mu\text{M}$ ) 0.000 0.169 0.508 1.  
524 4.572 13.71641.148 123.444 370.333 1111.000 33  
33.000

生育 (Absorbance at 650nm) 0.436 0.442 0.447 0.449  
0.454 0.430 0.1340.083 0.054 0.049 0.040

2,4-Dichlorophenoxy acetic acid 濃度 ( $\mu\text{M}$ ) 0.000  
0.339 1.016 3.048 9.14427.432 82.296 246.889 740.6  
67 2222.000 6666.000

生育 (Absorbance at 650nm) 0.427 0.430 0.438 0.443  
0.446 0.434 0.4210.390 0.099 0.044 0.052

Formaldehyde 濃度 ( $\mu\text{M}$ ) 0.000 0.085 0.254 0.762 2.  
285 6.856 20.56861.704 185.111 555.333 1666.000

生育 (Absorbance at 650nm) 0.437 0.428 0.444 0.446  
0.442 0.427 0.4330.429 0.430 0.382 0.077

p-Nonylphenol 濃度 ( $\mu\text{M}$ ) 0.000 0.034 0.102 0.305

0.914 2.741 8.22224.667 74.000 222.000 666.000  
 生育 (Absorbance at 650nm) 0.403 0.387 0.412 0.408  
 0.388 0.364 0.2930.216 0.182 0.142 0.022  
 Sodium Arsenite 濃度 ( $\mu\text{M}$ ) 0.000 0.017 0.051 0.152  
 0.457 1.370 4.11112.333 37.000 111.000 333.000  
 生育 (Absorbance at 650nm) 0.407 0.407 0.403 0.436  
 0.416 0.399 0.3830.365 0.333 0.242 0.129  
 Thiuram 濃度 ( $\mu\text{M}$ ) 0.000 0.017 0.051 0.152 0.457  
 1.370 4.111 12.33337.000 111.000 333.000  
 生育 (Absorbance at 650nm) 0.404 0.401 0.426 0.416  
 0.391 0.362 0.2530.191 0.083 0.037 0.047  
 2,4,5-Trichlorophenol 濃度 ( $\mu\text{M}$ ) 0.000 0.169 0.508  
 1.524 4.572 13.71641.148 123.444 370.333 1111.000  
 3333.000  
 生育 (Absorbance at 650nm) 0.411 0.398 0.397 0.390  
 0.313 0.063 0.0500.052 0.049 0.041 0.077  
 Potassium dichromate 濃度 ( $\mu\text{M}$ ) 0.000 0.002 0.005  
 0.015 0.045 0.1360.407 1.222 3.667 11.000 33.000  
 生育 (Absorbance at 650nm) 0.323 0.303 0.322 0.318  
 0.311 0.303 0.2960.296 0.289 0.273 0.226  
 Triphenyltin chloride 濃度 ( $\mu\text{M}$ ) 0.000 0.000 0.001  
 0.002 0.005 0.0140.041 0.122 0.367 1.100 3.300  
 生育 (Absorbance at 650nm) 0.321 0.315 0.328 0.327  
 0.317 0.304 0.2820.280 0.237 0.197 0.118  
 【0016】  
 【表6】(6) *Pseudomonas synxantha* IF0 3913の化学  
 物質感受性  
 Methylmercury chloride 濃度 ( $\mu\text{M}$ ) 0.000 0.034 0.10  
 2 0.305 0.914 2.7418.222 24.667 74.000 222.000 66  
 6.000  
 生育 (Absorbance at 650nm) 0.719 0.716 0.728 0.733  
 0.736 0.476 0.0700.060 0.056 0.057 0.046  
 Nickel chloride 濃度 ( $\mu\text{M}$ ) 0.000 0.169 0.508 1.524  
 4.572 13.716 41.148123.444 370.333 1111.000 3333.  
 000  
 生育 (Absorbance at 650nm) 0.667 0.686 0.673 0.673  
 0.673 0.666 0.6620.666 0.659 0.542 0.051  
 2-Aminoanthracene 濃度 ( $\mu\text{M}$ ) 0.000 0.169 0.508 1.5  
 24 4.572 13.716 41.148123.444 370.333 1111.000 333  
 3.000  
 生育 (Absorbance at 650nm) 0.784 0.785 0.804 0.794  
 0.805 0.803 0.7690.723 0.682 0.548 0.150  
 Tributyltin chloride 濃度 ( $\mu\text{M}$ ) 0.000 0.003 0.010  
 0.030 0.091 0.2720.815 2.444 7.333 22.000 66.000  
 生育 (Absorbance at 650nm) 0.748 0.773 0.767 0.776  
 0.769 0.761 0.7610.729 0.351 0.077 0.057  
 Malathion 濃度 ( $\mu\text{M}$ ) 0.000 0.034 0.102 0.305 0.914  
 2.741 8.222 24.66774.000 222.000 666.000  
 生育 (Absorbance at 650nm) 0.717 0.714 0.708 0.696  
 0.695 0.680 0.6880.706 0.778 0.751 0.180

Phenol 濃度 ( $\mu\text{M}$ ) 0.000 0.847 2.540 7.620 22.861 6  
 8.584 205.753 617.2591851.778 5555.333 16666.000  
 生育 (Absorbance at 650nm) 0.624 0.649 0.646 0.615  
 0.594 0.541 0.4220.298 0.203 0.116 0.053  
 Lindane 濃度 ( $\mu\text{M}$ ) 0.000 0.339 1.016 3.048 9.144 2  
 7.432 82.296 246.889740.667 2222.000 6666.000  
 生育 (Absorbance at 650nm) 0.655 0.657 0.647 0.660  
 0.644 0.606 0.5930.597 0.571 0.451 -0.032  
 Pentachlorophenol 濃度 ( $\mu\text{M}$ ) 0.000 0.034 0.102 0.3  
 05 0.914 2.741 8.22224.667 74.000 222.000 666.000  
 生育 (Absorbance at 650nm) 0.770 0.775 0.774 0.763  
 0.756 0.726 0.7110.692 0.708 0.731 0.158  
 Trp-P-2(Acetate) 濃度 ( $\mu\text{M}$ ) 0.000 0.017 0.051 0.15  
 2 0.457 1.370 4.11112.333 37.000 111.000 333.000  
 生育 (Absorbance at 650nm) 0.701 0.712 0.726 0.723  
 0.723 0.714 0.7110.730 0.700 0.382 0.149  
 4-Nitroquinoline-N-oxide 濃度 ( $\mu\text{M}$ ) 0.000 0.001 0.  
 003 0.008 0.023 0.0700.210 0.630 1.889 5.667 17.00  
 0  
 生育 (Absorbance at 650nm) 0.746 0.754 0.768 0.748  
 0.753 0.741 0.7180.725 0.747 0.845 0.630  
 Benzo(a)pyrene 濃度 ( $\mu\text{M}$ ) 0.000 0.017 0.051 0.152  
 0.457 1.370 4.11112.333 37.000 111.000 333.000生育  
 (Absorbance at 650nm) 0.782 0.802 0.814 0.819 0.8  
 03 0.806 0.7930.775 0.773 0.774 0.558  
 Paraquat 濃度 ( $\mu\text{M}$ ) 0.000 0.051 0.152 0.457 1.372  
 4.115 12.346 37.037111.111 333.333 1000.000  
 生育 (Absorbance at 650nm) 0.680 0.691 0.679 0.669  
 0.659 0.638 0.5550.440 0.308 0.221 0.154  
 Maneb 濃度 ( $\mu\text{M}$ ) 0.000 0.017 0.051 0.152 0.457 1.3  
 70 4.111 12.333 37.000111.000 333.000  
 生育 (Absorbance at 650nm) 0.695 0.720 0.712 0.697  
 0.676 0.668 0.6690.692 0.760 0.808 0.261  
 Cadmium chloride 濃度 ( $\mu\text{M}$ ) 0.000 0.017 0.051 0.15  
 2 0.457 1.370 4.11112.333 37.000 111.000 333.000  
 生育 (Absorbance at 650nm) 0.677 0.704 0.696 0.698  
 0.683 0.676 0.6480.592 0.529 0.471 0.381  
 Bis-phenol-A 濃度 ( $\mu\text{M}$ ) 0.000 0.169 0.508 1.524 4.  
 572 13.716 41.148123.444 370.333 1111.000 3333.000  
 生育 (Absorbance at 650nm) 0.787 0.805 0.812 0.817  
 0.821 0.807 0.8210.836 0.573 0.686 0.455Di-2-ethy  
 lhexyl phthalate 濃度 ( $\mu\text{M}$ ) 0.000 0.042 0.127 0.38  
 1 1.143 3.42810.284 30.852 92.556 277.667 833.000  
 生育 (Absorbance at 650nm) 0.784 0.757 0.792 0.794  
 0.783 0.772 0.7730.772 0.788 0.783 0.582  
 2,5-Dichlorophenol 濃度 ( $\mu\text{M}$ ) 0.000 0.169 0.508 1.  
 524 4.572 13.71641.148 123.444 370.333 1111.000 33  
 33.000  
 生育 (Absorbance at 650nm) 0.788 0.805 0.810 0.818  
 0.822 0.824 0.8300.852 0.767 0.075 0.024

2,4-Dichlorophenoxy acetic acid 濃度 ( $\mu\text{M}$ ) 0.000  
0.339 1.016 3.048 9.144 27.432 82.296 246.889 740.6  
67 2222.000 6666.000

生育 (Absorbance at 650nm) 0.761 0.773 0.785 0.797  
0.801 0.795 0.8010.835 0.906 0.945 0.045

Formaldehyde 濃度 ( $\mu\text{M}$ ) 0.000 0.085 0.254 0.762 2.  
285 6.856 20.56861.704 185.111 555.333 1666.000

生育 (Absorbance at 650nm) 0.765 0.752 0.776 0.784  
0.785 0.779 0.7890.789 0.784 0.765 0.740

p-Nonylphenol 濃度 ( $\mu\text{M}$ ) 0.000 0.034 0.102 0.305  
0.914 2.741 8.22224.667 74.000 222.000 666.000

生育 (Absorbance at 650nm) 0.758 0.762 0.775 0.763  
0.737 0.708 0.7260.621 0.484 0.420 0.289

Sodium Arsenite 濃度 ( $\mu\text{M}$ ) 0.000 0.017 0.051 0.152  
0.457 1.370 4.11112.333 37.000 111.000 333.000

生育 (Absorbance at 650nm) 0.776 0.773 0.786 0.778  
0.762 0.735 0.7150.680 0.663 0.615 0.520

Thiuram 濃度 ( $\mu\text{M}$ ) 0.000 0.017 0.051 0.152 0.457  
1.370 4.111 12.33337.000 111.000 333.000

生育 (Absorbance at 650nm) 0.769 0.773 0.774 0.771  
0.773 0.756 0.7370.703 0.652 0.624 0.354

2,4,5-Trichlorophenol 濃度 ( $\mu\text{M}$ ) 0.000 0.169 0.508  
1.524 4.572 13.71641.148 123.444 370.333 1111.000  
3333.000

生育 (Absorbance at 650nm) 0.750 0.759 0.763 0.759  
0.736 0.701 0.6570.562 0.044 0.033 0.081

Potassium dichlomite 濃度 ( $\mu\text{M}$ ) 0.000 0.002 0.005  
0.015 0.045 0.1360.407 1.222 3.667 11.000 33.000

生育 (Absorbance at 650nm) 0.644 0.664 0.668 0.659  
0.651 0.631 0.6360.634 0.630 0.602 0.501

Triphenyltin chloride 濃度 ( $\mu\text{M}$ ) 0.000 0.000 0.001  
0.002 0.005 0.0140.041 0.122 0.367 1.100 3.300

生育 (Absorbance at 650nm) 0.624 0.631 0.621 0.636  
0.635 0.622 0.6210.641 0.672 0.738 0.418

【0017】

【表7】(7) Staphylococcus aureus IF0 3060の化学  
物質感受性

Methylmercury chloride 濃度 ( $\mu\text{M}$ ) 0.000 0.034 0.10  
2 0.305 0.914 2.7418.222 24.667 74.000 222.000 66  
6.000

生育 (Absorbance at 650nm) 0.184 0.198 0.200 0.189  
0.007 0.006 0.0060.007 0.008 0.007 0.005

Nickel chloride 濃度 ( $\mu\text{M}$ ) 0.000 0.169 0.508 1.524  
4.572 13.716 41.148123.444 370.333 1111.000 3333.  
000

生育 (Absorbance at 650nm) 0.237 0.232 0.226 0.227  
0.224 0.220 0.2160.216 0.208 0.111 0.0072-Aminoan

thracene 濃度 ( $\mu\text{M}$ ) 0.000 0.169 0.508 1.524 4.572  
13.716 41.148123.444 370.333 1111.000 3333.000

生育 (Absorbance at 650nm) 0.174 0.181 0.176 0.173

0.170 0.168 0.1670.155 0.124 0.121 0.033

Tributyltin chloride 濃度 ( $\mu\text{M}$ ) 0.000 0.003 0.010  
0.030 0.091 0.2720.815 2.444 7.333 22.000 66.000

生育 (Absorbance at 650nm) 0.154 0.177 0.185 0.183  
0.160 0.109 0.0850.045 0.020 0.010 0.029

Malathion 濃度 ( $\mu\text{M}$ ) 0.000 0.034 0.102 0.305 0.914  
2.741 8.222 24.66774.000 222.000 666.000

生育 (Absorbance at 650nm) 0.235 0.226 0.223 0.219  
0.216 0.211 0.2150.222 0.231 0.226 0.063

Phenol 濃度 ( $\mu\text{M}$ ) 0.000 0.847 2.540 7.620 22.861 6  
8.584 205.753 617.2591851.778 5555.333 16666.000

生育 (Absorbance at 650nm) 0.256 0.192 0.199 0.198  
0.197 0.193 0.1930.190 0.180 0.159 0.043

Lindane 濃度 ( $\mu\text{M}$ ) 0.000 0.339 1.016 3.048 9.144 2  
7.432 82.296 246.889740.667 2222.000 6666.000

生育 (Absorbance at 650nm) 0.177 0.095 0.085 0.080  
0.075 0.071 0.0800.074 0.106 0.055 -0.230

Pentachlorophenol 濃度 ( $\mu\text{M}$ ) 0.000 0.034 0.102 0.3  
05 0.914 2.741 8.22224.667 74.000 222.000 666.000

生育 (Absorbance at 650nm) 0.146 0.148 0.142 0.129  
0.107 0.090 0.0730.041 0.007 0.002 0.004

Trp-P-2(Acetate) 濃度 ( $\mu\text{M}$ ) 0.000 0.017 0.051 0.15  
2 0.457 1.370 4.11112.333 37.000 111.000 333.000

生育 (Absorbance at 650nm) 0.189 0.200 0.199 0.187  
0.176 0.143 0.0840.041 0.017 0.012 0.085

4-Nitroquinoline-N-oxide 濃度 ( $\mu\text{M}$ ) 0.000 0.001 0.  
003 0.008 0.023 0.0700.210 0.630 1.889 5.667 17.00  
0

生育 (Absorbance at 650nm) 0.182 0.185 0.185 0.183  
0.181 0.177 0.1850.188 0.191 0.170 0.104

Benzo(a)pyrene 濃度 ( $\mu\text{M}$ ) 0.000 0.017 0.051 0.152  
0.457 1.370 4.11112.333 37.000 111.000 333.000

生育 (Absorbance at 650nm) 0.162 0.164 0.156 0.158  
0.138 0.114 0.0940.076 0.068 0.062 0.094

Paraquat 濃度 ( $\mu\text{M}$ ) 0.000 0.051 0.152 0.457 1.372  
4.115 12.346 37.037111.111 333.333 1000.000生育 (A

bsorbance at 650nm) 0.249 0.241 0.218 0.217 0.217  
0.211 0.1960.177 0.174 0.175 0.161

Maneb 濃度 ( $\mu\text{M}$ ) 0.000 0.017 0.051 0.152 0.457 1.3  
70 4.111 12.333 37.000111.000 333.000

生育 (Absorbance at 650nm) 0.232 0.230 0.225 0.226  
0.223 0.215 0.2160.212 0.187 0.134 0.013

Cadmium chloride 濃度 ( $\mu\text{M}$ ) 0.000 0.017 0.051 0.15  
2 0.457 1.370 4.11112.333 37.000 111.000 333.000

生育 (Absorbance at 650nm) 0.237 0.233 0.221 0.215  
0.203 0.164 0.1590.123 0.090 0.076 0.029

Bis-phenol-A 濃度 ( $\mu\text{M}$ ) 0.000 0.169 0.508 1.524 4.  
572 13.716 41.148123.444 370.333 1111.000 3333.000

生育 (Absorbance at 650nm) 0.159 0.158 0.156 0.156  
0.158 0.163 0.1620.109 0.003 0.003 0.085

Di-2-ethylhexyl phthalate 濃度 ( $\mu\text{M}$ ) 0.000 0.042  
0.127 0.381 1.143 3.42810.284 30.852 92.556 277.66  
7 833.000

生育 (Absorbance at 650nm) 0.158 0.157 0.159 0.152  
0.153 0.150 0.1510.153 0.143 0.080 0.0692,5-Dichl  
orophenol 濃度 ( $\mu\text{M}$ ) 0.000 0.169 0.508 1.524 4.572  
13.71641.148 123.444 370.333 1111.000 3333.000

生育 (Absorbance at 650nm) 0.156 0.162 0.158 0.157  
0.156 0.152 0.0860.053 0.029 0.001 0.002

2,4-Dichlorophenoxy acetic acid 濃度 ( $\mu\text{M}$ ) 0.000  
0.339 1.016 3.048 9.14427.432 82.296 246.889 740.6  
67 2222.000 6666.000

生育 (Absorbance at 650nm) 0.158 0.159 0.155 0.159  
0.159 0.153 0.1460.116 0.066 0.005 0.011

Formaldehyde 濃度 ( $\mu\text{M}$ ) 0.000 0.085 0.254 0.762 2.  
285 6.856 20.56861.704 185.111 555.333 1666.000

生育 (Absorbance at 650nm) 0.160 0.159 0.163 0.164  
0.162 0.161 0.1590.161 0.160 0.156 0.147

p-Nonylphenol 濃度 ( $\mu\text{M}$ ) 0.000 0.034 0.102 0.305  
0.914 2.741 8.22224.667 74.000 222.000 666.000

生育 (Absorbance at 650nm) 0.158 0.165 0.164 0.167  
0.143 0.156 0.0700.068 0.052 0.055 0.160

Sodium Arsenite 濃度 ( $\mu\text{M}$ ) 0.000 0.017 0.051 0.152  
0.457 1.370 4.11112.333 37.000 111.000 333.000

生育 (Absorbance at 650nm) 0.148 0.148 0.148 0.147  
0.149 0.143 0.1410.131 0.094 0.094 0.070

Thiuram 濃度 ( $\mu\text{M}$ ) 0.000 0.017 0.051 0.152 0.457  
1.370 4.111 12.33337.000 111.000 333.000

生育 (Absorbance at 650nm) 0.145 0.150 0.150 0.153  
0.151 0.146 0.1340.092 0.029 0.006 0.004

2,4,5-Trichlorophenol 濃度 ( $\mu\text{M}$ ) 0.000 0.169 0.508  
1.524 4.572 13.71641.148 123.444 370.333 1111.000  
3333.000

生育 (Absorbance at 650nm) 0.152 0.155 0.161 0.154  
0.109 0.034 0.0060.005 0.005 0.006 0.000

Potassium dichlomite 濃度 ( $\mu\text{M}$ ) 0.000 0.002 0.005  
0.015 0.045 0.1360.407 1.222 3.667 11.000 33.000

生育 (Absorbance at 650nm) 0.241 0.227 0.225 0.224  
0.220 0.216 0.2190.222 0.218 0.207 0.188

Triphenyltin chloride 濃度 ( $\mu\text{M}$ ) 0.000 0.000 0.001  
0.002 0.005 0.0140.041 0.122 0.367 1.100 3.300

生育 (Absorbance at 650nm) 0.256 0.274 0.260 0.257  
0.255 0.254 0.2480.232 0.129 0.097 0.024

【0018】指標微生物としては、生育阻害を受けやすい種類の異なったものを多数選ぶのが好ましい。このような微生物としては、各化学物質に対する必須指標微生物を選定するのがよい。この必須指標微生物を選定するには、まず、各化学物質について、その大腸菌の生育を阻害する最低濃度を測定し、この最低阻害濃度より低い濃度で生育阻害を受ける微生物を複数選択する（1次ス

クリーニング）。次に、この1次スクリーニングで選択した微生物を、異なる濃度の指標化学物質の存在下で生育させ、その化学物質による生育阻害の特性を観察する。この結果から、1次スクリーニングで選択した微生物の中で最もその化学物質に感受性を示す微生物を、必須指標微生物として選ぶ。もちろん、指標微生物としては、この必須指標微生物の他に、大腸菌よりも生育阻害を受けやすい各種の微生物を指標微生物とすることができる。

【0019】前記表1～7に示した結果から理解されるように、Methylmercury chloride, Nickel chloride, 2-Aminoanthracene, Malathion, Phenol, Lindane等の指標化学物質は、Methylmercury chlorideを除いて、明らかに指標微生物に対する阻害が顕著である。ただし、Methylmercury chlorideとTributyltin chlorideについては指標微生物以外にも複数の微生物で顕著な生育阻害が認められた。Methylmercury chlorideについては、全ての指標微生物に対してほぼ同程度の阻害特性を示すが、このような化学物質は他の24種類では認められないことから、Methylmercury chlorideの特徴を示しているものと理解できる。Tributyltin chlorideについては、3種類の微生物に限って阻害を示すことから、これもその生育スペクトルがTributyltin chlorideの特徴を表しているものと理解することができる。以上のことから、上記の化学物質に対する指標微生物の生育特性又は生産スペクトル（微生物/化学物質濃度データ）は、化学物質の特徴を反映していることは明らかである。

【0020】Pentachlorophenol, Trp-P-2(Acetate), 4-Nitroquinoline-N-oxide, Benzo(a)pyrene, Paraquat, Maneb, Cadmium chlorideについては、これらの化合物に感受性を示す微生物が存在するために、生育スペクトルが、特徴的なものとなっている。例えば、Pentachlorophenolに対して、Acetobacter pasteurianus IF03129は感受性を示した。本微生物は本来、Nickel chlorideに対して感受性を示す微生物として選定したが、Pentachlorophenolにも感受性があると理解できる。しかしながら、他の微生物のPentachlorophenolとNickel chlorideに対する感受性が異なることから、その生育スペクトルは明らかに両化学物質が異なるものであることを示している。同様に、Trp-P-2(Acetate), 4-Nitroquinoline-N-oxide, Benzo(a)pyrene, Paraquat, Maneb, Cadmium chlorideについても、感受性を示す指標微生物が存在するが、当該微生物以外のスペクトルが異なることから、区別することができる。

【0021】Bis-phenol-A, Di-2-ethyl hexylphthalate, 2,5-Dichlorophenol, 2,4-Dichlorophenoxy acid, Formaldehyde, p-Nonylphenol, Sodium Arsenite, Thiuram, 2,4,5-Trichlorophenol, Potassium dichlomite, Triphenyltin chlorideについては、顕著に感受性を示す微生物は存在しなかった。これらの化合物の内、2,5-Dichloroph

enol, 2,4-Dichlorophenoxy acetic acid, 2,4,5-Trichlorophenolを除くと、これらの化合物に対する微生物の感受性が異なることから、化学物質の生育スペクトルは特徴的な結果となっている。2,5-Dichlorophenol, 2,4-Dichlorophenoxy acetic acid, 2,4,5-Trichlorophenolについては生育スペクトルが類似していた。しかしながらこれらの化合物は類似化合物であることから、その毒性も類似していることが推測され、生育スペクトルが類似するのは当然であると考えることができる。逆に、本発明法が化学物質の毒性を表現するために有効であることを示している例であると考えることができる。

【0022】本発明の方法は、試料化学物質の存在下で複数の指標微生物を生育する工程を含む。この場合の生育条件は、前記した指標微生物の存在下で指標化学物質を生育させたときと同じ条件である。また、本発明の方法は、前記生育工程における微生物濃度と試料化合物濃度との関係を測定する測定工程を含む。本発明の方法は、前記測定工程で得られた微生物／化学物質濃度データを、前記データバンクに収納されている指標微生物／

指標化学物質濃度データと照合する照合工程を含む。この照合工程において、試料化学物質と同一又は近似する指標微生物／指標化学物質濃度データが検出されたときには、その試料化合物は、微生物学的に、その検出されたデータにおける指標化学物質と同一又は近似するものと同定される。本発明に使用し得る試料化学物質は、高純度化学物質である必要はなく、化学物質を含む環境水や、化学物質で汚染された汚染水等であることができる。前記した各工程は、いずれも自動的に行うことができる。測定工程で得られたデータのデータバンクに収納されたデータとの照合は、コンピュータを用いて自動的に行うことができる。

【0023】

【発明の効果】本発明によれば、試料化学物質を微生物学的に同定することができる。即ち、その化学物質の種類や構造及びその化学物質の微生物に対する毒性を微生物学的手法により知ることができる。このような方法は、従来全く知られておらず、本発明により初めて得られたもので、その産業的意義は多大である。

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